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May 22, 2015

476243.ET.01

Mr. Tim Drexler
Superfund Division
U.S. Environmental Protection Agency
77 West Jackson Boulevard
Chicago, IL 60604-3590

Dear Mr. Drexler:

Subject: Final Pore Water Investigation Technical Memorandum
Southeast Rockford Groundwater Contamination Superfund Site
WA No. 175-TATA-05DK, Contract No. EP-S5-06-01

CH2M HILL is pleased to submit the final *Pore Water Investigation Technical Memorandum* for the Southeast Rockford Groundwater Contamination Superfund Site in Winnebago County, Illinois for your review. This document has also been provided to Brian Conrath (Illinois EPA) as indicated below. If you have any questions, please contact me at 414-847-0349.

Sincerely,

CH2M HILL

Renee M. Hunt

Renee M. Hunt, P.E.
Project Manager

Enclosure: Final Pore Water Investigation Technical Memorandum, Southeast Rockford Groundwater Contamination Superfund Site (2 hard copies and 1 CD)

c: Brian Conrath, IEPA (2 hard copies and 1 CD)
Rhonda Flynn, CO/USEPA Region 5 (w/o enclosure)
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Pore Water Investigation, Southeast Rockford Groundwater Contamination Superfund Site WA No. 175-TATA-05DK/Contract No. EP S5-06-01

PREPARED FOR: U.S. Environmental Protection Agency

PREPARED BY: CH2M HILL

DATE: May 22, 2015

Introduction

This technical memorandum documents the pore water investigation activities conducted near the Southeast Rockford Groundwater Contamination Superfund Site. This investigation was conducted by CH2M HILL for the U.S. Environmental Protection Agency (EPA) under Work Assignment No. 175-TATA-05DK, Contract No. EP S5-06-01.

The pore water investigation was conducted within the portion of the Rock River that may be impacted by the Southeast Rockford groundwater volatile organic compound (VOC) plume, as defined in the *Statistical Analysis of Chemicals Concentrations in Groundwater and Mapping* report (S.S. Papadopoulos 2012). The purpose of this investigation was to identify the potential discharge of groundwater to the groundwater-to-surface water interface (GSI), measure groundwater contaminants of concern (COCs) in the sediment pore water, and assess potential impacts to aquatic ecological receptors (fish and the benthic community). As part of the investigation, a water quality survey was conducted using the Trident Probe system to determine likely areas of GSI venting (upwelling or discharge). Collocated surface water and pore water samples were collected at locations of likely groundwater venting for analysis of site-related VOCs. Coastal Monitoring Associates, a GSI specialty consultant who developed the Trident Probe system, supported CH2M HILL as a subcontractor for the pore water investigation. Potential ecological impacts were assessed by comparing the COC concentrations to ecological screening benchmarks.

Site Description

The Southeast Rockford Groundwater Contamination Superfund Site (site) is located in the City of Rockford, Winnebago County, Illinois (Figure 1) and consists of an approximately 7.5-square-mile area (Figure 2). The overall site is defined in the June 2002 Record of Decision as the area where groundwater contamination exceeds 10 parts per billion of total chlorinated VOCs (EPA 2002). Benzene, ethylbenzene, toluene, and xylenes are also identified in the Record of Decision as groundwater COCs. Much of the groundwater plume underlies an area of mixed residential and commercial properties extending from Sandy Hollow Road to North 23rd Avenue and from Alpine Road west to the Rock River (Figure 2). There are four primary source areas within the Site: Area 4, Area 7, Area 9/10, and Area 11. A description of each source area and a summary of investigations/remediation activities previously conducted in each source area is presented in the *Uniform Federal Policy Quality Assurance Project Plan* (UFP-QAPP) (CH2M HILL 2014).

The segment of the Rock River included in the investigation is approximately 2.2 miles long and extends from just south of 15th Avenue south to Ulysses S. Grant Memorial Highway (U.S. Hwy 20). The pore water investigation was conducted along the eastern shoreline of the Rock River.

Land use in the surrounding area is primarily industrial and residential. Industrial and residential areas, including a wastewater treatment plant that discharges to the river, are located along the eastern shoreline of the investigation area. An RV park and residential areas are present on the western shoreline of the river.

There is an absence of soft sediment over the hard-pan rock of the river floor in some portions of the investigation area. The water depth of the investigation area (within 100 feet from shore) ranged from less than 1.5 feet to 8.4 feet.

Field Activities

Field investigation activities were conducted in accordance with the UFP-QAPP (CH2M HILL 2014) from July 14 through 18, 2014. The activities consisted of a pore water/surface water quality survey to locate areas of groundwater venting at the GSI, followed by pore water/surface water sampling. Deviations from the UFP-QAPP are presented in Table 1. The deviations, as they pertain to the field investigation activities, are also discussed in the following sections. Attachment 1 includes Coastal Monitoring Associates' post-pore-water survey and sampling summary report. Attachment 2 is a photograph log of the pore water survey and sampling activities.

Survey

A transect-based water quality survey was conducted using the Trident Probe system, a direct-push system equipped with conductivity and temperature (C/T) sensors, and water sampling probes. At each location, in situ conductivity and temperature measurements were collected for surface and pore water using the Trident Probe C/T sensors. Additionally, ex situ water quality measurements of C/T, as well as pH, oxidation-reduction potential, and total dissolved solids were collected through the Trident Probe system for surface water and pore water using a Myron L Ultrameter. The focus of the survey was on C/T differential between surface water and pore water. The C/T differential between the media can indicate potential groundwater discharge zones. In situ C/T measurements for the survey locations are presented in Table 2. Stations with elevated pore water conductivity relative to surface water and/or lower pore water temperatures relative to surface water were considered to be potentially influenced by groundwater discharge. For this evaluation, in situ temperature (Trident Probe sensor) and ex situ conductivity (Ultrameter) are considered the most reliable. For temperature, in situ measures reflect the most accurate real-time conditions because the drawing of water through the sampling apparatus for measures can artificially alter temperature. For conductivity, measurement of the ex situ sample is considered more accurate because the Trident Probe sensor can be influenced by particulates touching the instrument while inserted into the sediment. The ex situ sample is free of large particulates and represents a more realistic estimation of interstitial conditions.

According to the UFP-QAPP (CH2M HILL 2014), collocated C/T measurements were proposed along 60 transects. Through discussions with EPA, the number of survey transects was reduced to 19 (Figure 3) due to challenges related to the extremely rocky substrate that prevented Trident Probe penetration or greatly increased the time on station to achieve penetration. Each transect was positioned perpendicular to the shore, and water quality measurements for surface water and pore water were attempted at four points along each transect. Surface water measurements were collected from within 4 inches of the sediment surface. Pore water measurements were collected at a depth of 12 inches below sediment surface, except at Transect 4-South (50 feet), Transect 14-South (50 feet), and Transect 14-South (75 feet) as described in Table 1.

Of the 85 survey locations where C/T measurements were attempted, Trident Probe penetration was achieved at 38 of those locations. At the other 47 survey locations, the Trident probe reached refusal due to rocky substrate, or the location was not accessible for sampling as they fell onshore (Transect 26-South).

The closest United States Geological Survey (USGS) gauging station in the Lower Rock Basin is in Byron, Illinois (http://www.usgs.gov/water/), which is located approximately 10 to 11 miles downstream of the site. The stage ranged from approximately 7.0 feet in mid-June to approximately 5.5 feet in mid-Sept, with a peak of approximately 11.5 feet the first week in July. During the survey, the river stage at Byron, Illinois, ranged from 9.25 feet on July 14, 2014, to about 8.25 feet on July 18, 2014. The river stage was declining at the time of this study. While there is no ideal time to conduct a pore water study, these conditions are not believed to have negatively impacted the study results. It is likely best that the study was conducted as stage was falling (likely better groundwater communication with pore water) as opposed to increasing (potential dilution with runoff/surface water).

Sampling

According to the UFP-QAPP (CH2M HILL 2014), surface water and pore water samples were to be collected after completion of the pore water survey. However, the rocky substrate and swiftly flowing river slowed the pore water survey and would have delayed return navigation to survey points for later sampling. After discussions with EPA and prior to the start of sampling activities, the sampling approach was modified to collect pore water and surface water samples during the pore water survey at any location where the Trident Probe system successfully penetrated and survey measurements were collected. Areas of likely groundwater venting were identified based upon differentials between the surface water and pore water C/T measurements at a given survey location, and samples collected within these areas were recommended to EPA for submittal to the laboratory for chemical analyses. A total of 13 pore water and 14 surface water samples were submitted for analysis of site-specific VOCs and hardness. The sample analytes included hardness and site-specific VOCs (1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, 1,2-dichloroethene, benzene, ethylbenzene, toluene, xylenes, tetrachloroethene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, vinyl chloride, and dichloromethane).

Quality Assurance/Quality Control Samples

Per the UFP-QAPP (CH2M HILL 2014), quality assurance/quality control samples were collected for VOCs as follows:

- Field duplicates
- Matrix spike (MS)/matrix spike duplicates (MSD)
- Equipment blanks
- Field blanks
- Trip blanks

Field and equipment blanks were collected at a frequency of one per week, and MS/MSDs were collected at a frequency of at least 5 percent. In accordance with the UFP-QAPP (CH2M HILL 2014), MS/MSD samples were not collected for hardness samples. Field duplicate samples were planned for a frequency of 10 percent for each medium (surface water and pore water). Field duplicates were collected during the field effort under the assumption that 10 pore water and 10 surface water samples would be submitted for laboratory analysis. When the decision to submit 13 pore water and 14 surface water samples for analysis was made, sufficient field duplicates had not been collected to achieve the 10 percent field duplicate frequency. With the additional samples submitted for analysis, a 7.4 percent field duplicate frequency was achieved for this event. Field duplicate samples are collected to assess the precision of the data collection activity, including sampling, sample handling and storage, and site heterogeneity. Collecting field duplicate samples at a reduced frequency did not negatively impact the quality of the data collected. The field duplicate samples that were collected met acceptance criteria.

Data Validation

In accordance with the UFP-QAPP (CH2M HILL 2014), a Level III validation was performed on 100 percent of data, and a Level IV validation was performed on 10 percent of data. Validated analytical results are presented in Tables 3 and 4.

Results

Survey

In situ C/T measurements for the survey locations are presented in Table 2. All in situ and ex situ water quality measurements are presented Attachment 1.

Based on the survey results, the following C/T differential categories were assigned to each location to prioritize locations where groundwater is most likely discharging and to aid in the selection of samples to submit for laboratory analyses:

- 1—strong conductivity and temperature differential[1]
- 2—strong conductivity differential only
- 3—strong temperature differential only

The C/T differentials were taken into account when selecting sample locations along the groundwater plume boundary, as these conditions are most indicative of potential venting of groundwater to surface water. Samples were preferentially collected at locations that had both a strong conductivity (>200 microSiemens per centimeter (µS/cm)) and temperature (>1° Celsius) differential. If a strong C/T differential was not present along portions of the plume boundary, then samples were collected at locations with either a strong conductivity differential or a strong temperature differential. Only one sample set (PW-02/SW-02) was collected in a location that did not have a strong conductivity or temperature differential. That sample location was selected in order to have samples representative of the northern extent of the estimated groundwater contaminant plume. A summary of the pore water and surface water sample locations is included in Table 2 and shown in Figure 4. Background surface water and pore water samples were collected at locations upstream of the groundwater VOC plume.

Sampling

In accordance with the UFP-QAPP (CH2M HILL 2014), analytical results were compared to EPA Region 3 Ecological Freshwater Screening Values (EPA 2006), Illinois Environmental Protection Agency's (IEPA's) Chronic Aquatic Life Criteria (IEPA 2013), and EPA Region 5 Ecological Screening Levels (EPA 2003).

Toluene was detected in surface water sample SW-12 at a concentration of 0.23 J micrograms per liter, which did not exceed ecological screening benchmarks. No other VOCs were detected in surface water. Table 3 summarizes the surface water sample analytical results.

Eight VOCs (1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, tetrachloroethene, toluene, trichloroethene, and vinyl chloride) were detected in site pore water samples. VOCs were detected at eight pore water sample locations across six transects. All VOCs were detected at concentrations less than ecological screening benchmarks. VOCs were not detected in the background pore water sample. Site-specific VOCs detected at each pore water sample location are presented in Figure 4 and summarized in Table 4.

Conclusions

The following conclusions are based on the results of the Trident Probe survey and sampling effort:

- Groundwater near the Southeast Rockford Site is discharging to the Rock River based on C/T survey results and the detection of VOCs in site pore water.
- VOC concentrations in pore water were well below ecological screening benchmarks, indicating that no adverse impacts to the benthic community are expected.

The results of this investigation suggest that the aquatic community in the Rock River is not impacted by the Southeast Rockford groundwater plume. However, the investigation is limited in temporal scale in that the data represent a single groundwater discharge condition. Concentrations of VOCs in the groundwater monitoring well network are greater than those seen in the pore water but are still below the ecological screening benchmarks. Sufficient data are not available to derive attenuation factors for the contaminant concentrations between groundwater and pore water. However, based on discussion with the EPA ecological risk assessor, it was agreed that the concentrations of VOCs in groundwater and pore water relative to the ecological screening benchmarks suggest that further investigation of the Rock River pore water concentrations should be performed if a 10-fold increase in groundwater concentrations over time are observed. A 10-fold increase in groundwater concentrations would signify an increase that is inconsistent with historical site trends and an indicator that

[1] For the purpose of this study, a strong (significant) temperature differential was considered more than 1.0 degree Celsius. A strong conductivity differential was considered greater than 200 microSiemens per centimeter (µS/cm).

contaminant concentrations in pore water would likely be increasing. Additionally, a 10-fold increase in groundwater concentrations is a conservative benchmark for further investigation as a 10-fold increase in pore water concentrations would still be less than ecological screening criteria at most sample locations.

References

CH2M HILL. 2014. *Final Uniform Federal Policy Quality Assurance Project Plan, Southeast Rockford Groundwater Contamination Superfund Site Technical Assistance, Winnebago County, Illinois.* January.

Illinois Environmental Protection Agency (IEPA). 2013. *Illinois Environmental Protection Agency, Derived Water Quality Criteria. http://www.epa.illinois.gov/topics/water-quality/standards/derived-criteria/index.* April.

S.S. Papadopoulos & Associates, INC. 2012. *Statistical Analysis of Chemicals Concentrations in Groundwater and Mapping.* September.

U.S. Environmental Protection Agency (EPA). 2006. EPA Region 3 Biological Technical Assistance Group Screening Benchmarks. http://www.epa.gov/reg3hwmd/risk/eco/index.htm.

U.S. Environmental Protection Agency (EPA). 2003. *U.S. EPA Region 5, RCRA, Ecological Screening Levels.* August.

U.S. Environmental Protection Agency (EPA). 2002. *Superfund Record of Decision: Southeast Rockford Ground Water Contamination.* June.

Tables

TABLE 1
Summary of Deviations from the UFP-QAPP
Southeast Rockford Groundwater Contamination Site, Rockford, Illinois

Type of Deviation	Deviation from the UFP-QAPP
Number of pore water survey transects and locations reduced	Rocky substrate throughout the Rock River survey area made penetration of the Trident Probe into the sediment impossible at many locations. After discussions with EPA, the number of planned pore water survey transects was reduced from what was specified in the UFP-QAPP. Of the 85 collocated pore water survey locations attempted, the Trident Probe could be inserted at 38 locations (refusal at 46 locations). Additionally, the proposed survey location 100 feet from the shoreline along transect 26 could not be accessed as it fell on an island within the river.
Sampling approach	Unanticipated rocky substrate conditions increased the time to access and survey locations, slowing the survey process. After discussions with EPA, the sampling approach was adjusted, and samples were collected at all locations where survey measurements were possible. Upon completion of the pore water survey, the pore water survey results were evaluated to identify locations where groundwater venting to surface water was likely. Pore water and surface water samples collected from areas of likely groundwater venting were selected by EPA and CH2M HILL and were submitted for laboratory analyses.
Quantity of pore water and surface water samples	At the direction of EPA, more pore water and surface water samples were submitted for laboratory analysis than were indicated in the UFP-QAPP. A total of 13 pore water and 14 surface water samples were submitted for analysis of site-specific VOCs and hardness.
Depth of collection for pore water samples and pore water water quality parameters	The planned deployment depth for the Trident Probe system for collection of water quality parameters and/or pore water samples could not be achieved (less than 12 inches) at three survey locations (Transect 4-South at 50 feet, Transect 14-South at 50 feet, and Transect 14-South at 75 feet) due to the rocky substrate within the river.
Frequency of field duplicate samples	Field duplicate samples were collected at a frequency of 7.4 percent for VOCs instead of 10 percent as indicated in the UFP-QAPP. Field duplicates were collected during the field effort under the assumption that 10 pore water and 10 surface water samples would be submitted for laboratory analysis. When the decision to submit 13 pore water and 14 surface water samples for analysis was made, sufficient field duplicates had not be collected to achieve the 10 percent field duplicate frequency. Collecting field duplicate samples at a reduced frequency did not negatively impact the quality of the data collected. The field duplicate samples that were collected met acceptance criteria.

EPA = U.S. Environmental Protection Agency
UFP-QAPP = Uniform Federal Policy Quality Assurance Project Plan
VOCs = volatile organic compounds

TABLE 2

Trident Probe Water Quality Measurements

Southeast Rockford Groundwater Contamination Site, Rockford, Illinois

Transect	Distance from Shore (feet)	Sample ID	Ex Situ Conductivity (µS/cm)			In Situ Temperature (Degrees Celsius)			Differential Category
			Surface Water	Pore Water	*Differential (Delta)*	Surface Water	Pore Water	*Differential (Delta)*	
North (Background)									
1 (North)	25	--	R	R	--	R	R	--	
	50	--	594.2	627.4	*33.2*	23.557	23.378	*-0.179*	
	75	--	672.4	729.8	*57.4*	23.302	23.042	*-0.260*	
	100	--	592.2	790.2	*198*	23.372	22.99	*-0.382*	
3 (North)	18	PW-01 SW-01	672.5	675.7	*3.2*	21.748	20.573	*-1.175*	3
	25	--	R	R	--	R	R	--	
	50	--	R	R	--	R	R	--	
	75	--	R	R	--	R	R	--	
	100	--	R	R	--	R	R	--	
5 (North)	18	SW-02	604.8	774.8	*170*	21.486	21.398	*-0.088*	
	25	--	R	R	--	R	R	--	
	50	--	R	R	--	R	R	--	
	75	--	R	R	--	R	R	--	
	100	--	R	R	--	R	R	--	
South (Site)									
2 (South)	25	PW-03 SW-03	604.8	774.8	*170*	22.662	21.788	*-0.874*	
	50	--	R	R	--	R	R	--	
	75	--	R	R	--	R	R	--	
	100	--	R	R	--	R	R	--	
4 (South)	25	--	R	R	--	R	R	--	
	50b	--	597.7	841.6	*243.9*	22.939	22.578	*-0.361*	2
	66	--	604.4	897.5	*293.1*	21.636	21.182	*-0.454*	2
	75	--	596.8	967.1	*370.3*	23.990	22.612	*-1.378*	1
	100	--	593.3	593.7	*0.4*	23.924	22.897	*-1.027*	3
8 (South)	15	PW-04 SW-04	623.3	1053	*429.7*	22.452	19.437	*-3.015*	1
	50	--	R	R	--	R	R	--	
	75	--	R	R	--	R	R	--	
	100	--	R	R	--	R	R	--	
10 (South)	25	--			*0*	22.325	19.98	*-2.345*	3
	50	--	R	R	--	R	R	--	
	75	--	R	R	--	R	R	--	
	100	--	R	R	--	R	R	--	
	25	PW-05 SW-05	590	1185	*595.0*	22.259	18.711	*-3.548*	1

TABLE 2

Trident Probe Water Quality Measurements

Southeast Rockford Groundwater Contamination Site, Rockford, Illinois

Transect	Distance from Shore (feet)	Sample ID	Ex Situ Conductivity (µS/cm)			In Situ Temperature (Degrees Celsius)			Differential Category
			Surface Water	Pore Water	*Differential (Delta)*	Surface Water	Pore Water	*Differential (Delta)*	
14 (South)	50	PW-06 SW-06	608.5	850.2	*658.0*	22.885	22.441	*-0.444*	2
	75	--	626.3	776.6	*557.0*	22.868	22.543	*-0.325*	2
	100	--	R	R	--	R	R	--	
18 (South)	7	PW-07 SW-07	588.2	1190	*601.8*	21.289	21.193	*-0.096*	2
	25	--	R	R	--	R	R	--	
	50	--	R	R	--	R	R	--	
	75	PW-08 SW-08	606.3	969.4	*809.0*	22.836	22.248	*-0.588*	2
	100	--	R	R	--	R	R	--	
22 (South)	25	--	589.1	625.8	*36.7*	21.72	21.33	*-0.39*	
	50	--	R	R	--	R	R	--	
	75	--	R	R	--	R	R	--	
	100	--	R	R	--	R	R	--	
26 (South)	2	PW-09 SW-09	618.7	1027	*408.3*	22.48	20.709	*-1.771*	1
	25	--	R	R	--	R	R	--	
	50	--	R	R	--	R	R	--	
	75	PW-10 SW-10	588.7	724.8	*136.1*	22.074	21.064	*-1.01*	3
	100[a]	--	--	--	--	--	--	--	
30 (South)	2	--	616.5	597	*-19.5*	22.543	21.546	*-0.997*	
	25	--	R	R	--	R	R	--	
	50	--	R	R	--	R	R	--	
	75	--	R	R	--	R	R	--	
	100	--	R	R	--	R	R	--	
32 (South)	2	--	592.9	923	*330.1*	23.935	21.370	*-2.565*	1
	25	--	596.5	797.5	*201*	23.932	22.316	*-1.616*	1
	50	--	R	R	--	R	R	--	
	75	--	R	R	--	R	R	--	
	100	--	R	R	--	R	R	--	
34 (South)	25	--	597.2	684.5	*87.3*	22.45	21.575	*-0.875*	
	50	--	R	R	--	R	R	--	
	75	--	R	R	--	R	R	--	
	100	--	R	R	--	R	R	--	

TABLE 2

Trident Probe Water Quality Measurements

Southeast Rockford Groundwater Contamination Site, Rockford, Illinois

Transect	Distance from Shore (feet)	Sample ID	Ex Situ Conductivity (µS/cm)			In Situ Temperature (Degrees Celsius)			Differential Category
			Surface Water	Pore Water	*Differential (Delta)*	Surface Water	Pore Water	*Differential (Delta)*	
38 (South)	5	PW-11 SW-11	594.7	1158	*563.3*	22.292	21.214	*-1.078*	1
	25	--	R	R	--	R	R	--	
	50	--	607.4	598.3	*84*	22.872	21.935	*-0.937*	
	75	--	609.1	637.2	*125*	22.627	21.735	*-0.892*	
	100	--	R	R	--	R	R	--	
42 (South)	25	--	607.9	2222	*1614.1*	22.221	21.911	*-0.31*	2
	50	--	R	R	--	R	R	--	
	75	--	R	R	--	R	R	--	
	100	--	R	R	--	R	R	--	
46 (South)	25	PW-12 SW-12	845.4	1485	*639.6*	21.073	21.012	*-0.061*	2
	50	PW-13 SW-13	953	1120	*167*	22.38	20.829	*-1.551*	3
	75	--	609.2	635.8	*26.6*	22.507	21.64	*-0.867*	
	100	--	608.7	602.8	*-5.9*	22.372	22.095	*-0.277*	
53 (South)	5	PW-14 SW-14	657.5	2428	*1770.5*	21.638	20.644	*-0.994*	2
	25	--	R	R	--	R	R	--	
	50	--	R	R	--	R	R	--	
	75	--	R	R	--	R	R	--	
	100	--	R	R	--	R	R	--	

"--" indicated not applicable

µS/cm = microSeimens per centimeter

R = No data collected due to refusal of the Trident Probe in rocky substrate

[a]The survey location along transect 26 located 100 feet from the eastern shoreline fell on land, on an island in the river.

High Delta T considered < -1.0; shaded green

High Delta C considered > 200 µS/cm; shaded red

TABLE 3
Analytical Results (July 2014)—Surface Water
Southeast Rockford Groundwater Contamination Site, Rockford, Illinois

				North (Background)		South (Site)												
				Transect 3	Transect 5	Transect 2	Transect 8	Transect 14			Transect 18		Transect 26		Transect 38	Transect 46		Transect 53
		Screening Values		SW-01 14CR02-02 7/17/2014	SW-02 14CR02-04 7/17/2014	SW-03 14CR02-07 7/15/2014	SW-04 14CR02-09 7/15/2014	SW-05 14CR02-11 7/15/2014	SW-05 14CR02-03 Duplicate	SW-06 14CR02-13 7/18/2014	SW-07 14CR02-15 7/16/2014	SW-08 14CR02-17 7/18/2014	SW-09 14CR02-20 7/16/2014	SW-10 14CR02-22 7/16/2014	SW-11 14CR02-19 7/16/2014	SW-12 14CR02-28 7/17/2014	SW-13 14CR02-30 7/17/2014	SW-14 14CR02-32 7/18/2014
Constituent	IEPA[a]	Region 5[b]	Region 3[b]	N-3-18'	N-5-18'	S-2-25'	S-8-15'	S-14-25'	S-14-25'	S-14-50'	S-18-7'	S-18-75'	S-26-2'	S-26-75'	S-38-5'	S-46-25'	S-46-50'	S-53-5'
Volatile Organic Compounds (µg/L)																		
1,1,1-Trichloroethane	390	76	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	4,400	500	1,200	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	2,000	47	47	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	240	65	25	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	4,500	910	100	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethene (mixed isomers)	1,100	NA	590	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Benzene	NA	114	370	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	NA	14	90	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene Chloride	1,400	940	98.1	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	150	45	111	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	NA	253	2	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.23 J	0.5 U	0.5 U
Trichloroethene	940	47	21	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Chloride	1,700	930	930	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylenes (Total)	NA	27	13	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Other Parameters																		
Hardness (mg/L)	NA	NA	NA	300	290	290	300	290	--	310	290	300	300	290	300	330	320	310

[a]IEPA Chronic Water Quality Criteria April 2013 (http://www.epa.state.il.us/water/water-quality-standards/water-quality-criteria-list.pdf)
[b]EPA Region 5 Ecological screening levels August 2003 (http://epa.gov/region5/waste/cars/pdfs/ecological-screening-levels-200308.pdf)
[c]EPA Region 3 ESLs December 2014 (http://www.epa.gov/reg3hscd/risk/eco/btag/sbv/fw/screenbench.htm)
"--" indicates a field duplicate sample was not collected for hardness
NA = not applicable
mg/L = milligrams per liter
µg/L = micrograms per liter
U = Undetected: The analyte was analyzed for, but not detected or is qualified as nondetect because of blank contamination.
J = Estimated. The analyte was positively identified; the quantitation is an estimation because of discrepancies in meeting certain analyte-specific quality control criteria.
Highlighted concentrations indicate detections

TABLE 4
Analytical Results (July 2014) —Pore Water
Southeast Rockford Groundwater Contamination Site, Rockford, Illinois

				North (Background)	South (Site)												
				Transect 3	Transect 2	Transect 8	Transect 14			Transect 18		Transect 26		Transect 38	Transect 46		Transect 53
		Screening Values		PW-01	PW-03	PW-04	PW-05	PW-05	PW-06	PW-07	PW-08	PW-09	PW-10	PW-11	PW-12	PW-13	PW-14
				14CR02-01	14CR02-06	14CR02-08	14CR02-10	14CR02-05	14CR02-12	14CR02-14	14CR02-16	14CR02-18	14CR02-21	14CR02-27	14CR02-29	14CR02-31	14CR02-33
				7/17/2014	7/15/2014	7/15/2014	7/15/2014	Duplicate	7/18/2014	7/16/2014	7/18/2014	7/16/2014	7/16/2014	7/16/2014	7/17/2014	7/17/2014	7/18/2014
Constituent	IEPA[a]	Region 5[b]	Region 3[c]	N-3-18'	S-2-25'	S-8-15'	S-14-25'	S-14-25'	S-14-50'	S-18-7'	S-18-75'	S-26-2'	S-26-75'	S-38-5'	S-46-25'	S-46-50'	S-53-5'
Volatile Organic Compounds (µg/L)																	
1,1,1-Trichloroethane	390	76	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3.7	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	4,400	500	1,200	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	2,000	47	47	1 U	1 U	3.7	4.1	4	2.1	1 U	1 U	1	6.1	1 U	1 U	1 U	1 U
1,1-Dichloroethene	240	65	25	1 U	1 U	1 U	1.1	1	0.71 J	1 U	1 U	1 U	1.1	1 U	1 U	1 U	1 U
1,2-Dichloroethane	4,500	910	100	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethene (mixed isomers)	1,100	NA	590	2 U	2 U	4.6	6.5	6.7	1.7 J	2 U	0.74 J	2 U	2.9	1.4 J	2 U	2 U	2 U
Benzene	NA	114	370	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	NA	14	90	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene Chloride	1,400	940	98.1	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	150	45	111	1 U	1 U	1 U	8.3	8.4	0.69 J	1 U	1 U	1 U	1.2	1 U	1 U	1 U	1 U
Toluene	NA	253	2	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.27 J	0.5 U	0.5 U	0.64
Trichloroethene	940	47	21	0.5 U	0.5 U	0.5 U	2.8	2.7	0.27 J	0.5 U	0.86	0.5 U	3.6	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Chloride	1,700	930	930	0.5 U	0.5 U	0.9	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.48 J	1.5	0.5 U	0.5 U	0.5 U
Xylenes (Total)	NA	27	13	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Other Parameters																	
Hardness (mg/L)	NA	NA	NA	310	500	510	490	–	560	400	970	490	390	540	660	380	1,400

[a]IEPA Chronic Water Quality Criteria April 2013 (http://www.epa.state.il.us/water/water-quality-standards/water-quality-criteria-list.pdf)
[b]EPA Region 5 Ecological screening levels August 2003 (http://epa.gov/region5/waste/cars/pdfs/ecological-screening-levels-200308.pdf)
[c]EPA Region 3 ESLs December 2014 (http://www.epa.gov/reg3hscd/risk/eco/btag/sbv/fw/screenbench.htm)
"–" indicates a field duplicate sample was not collected for hardness
NA = not applicable
mg/L = milligrams per liter
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U = Undetected: The analyte was analyzed for, but not detected or is qualified as nondetect because of blank contamination.
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Highlighted concentrations indicate detections

Figures

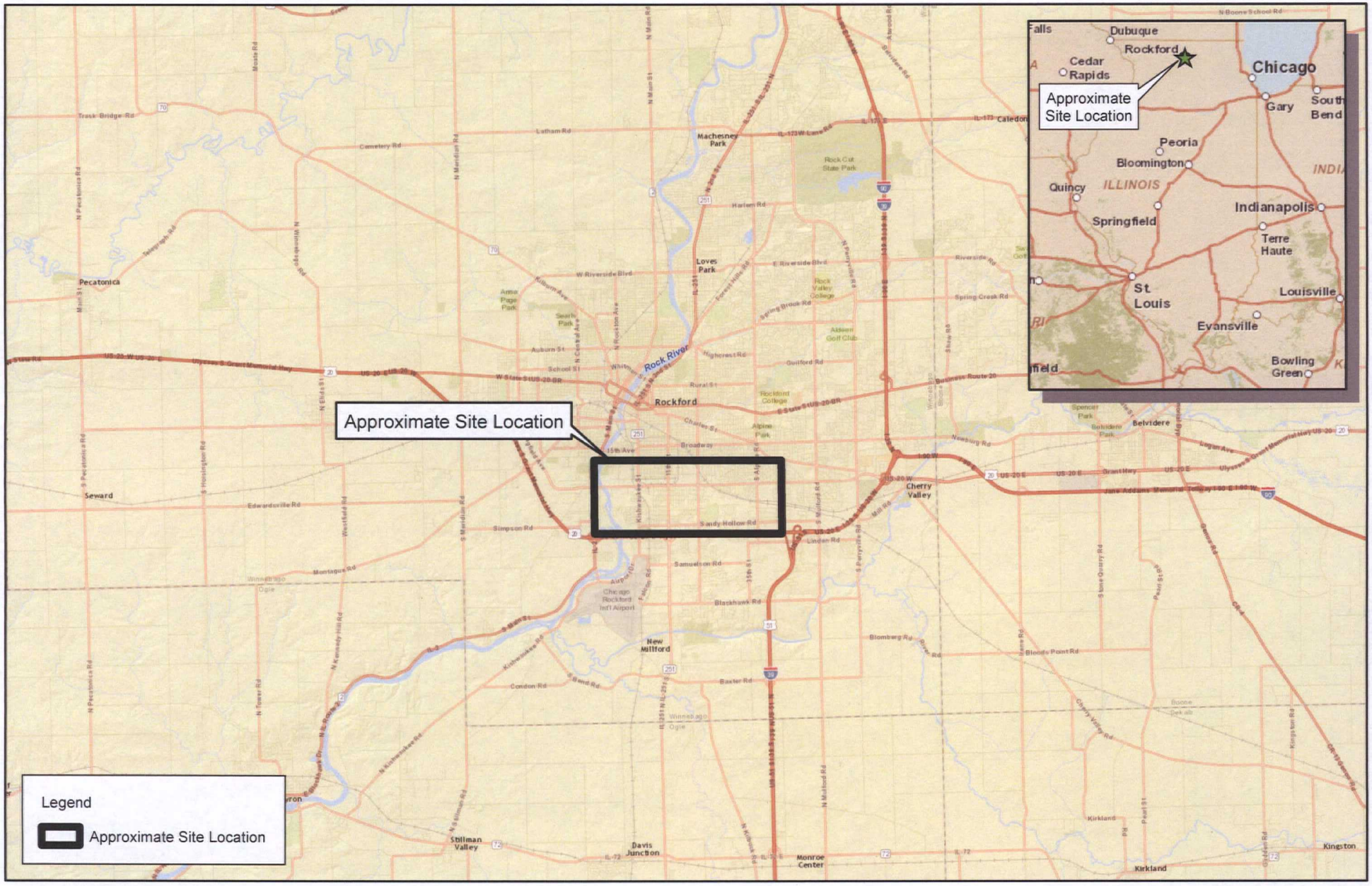

Figure 1
Site Map
Southeast Rockford Groundwater Contamination Site
Rockford, IL

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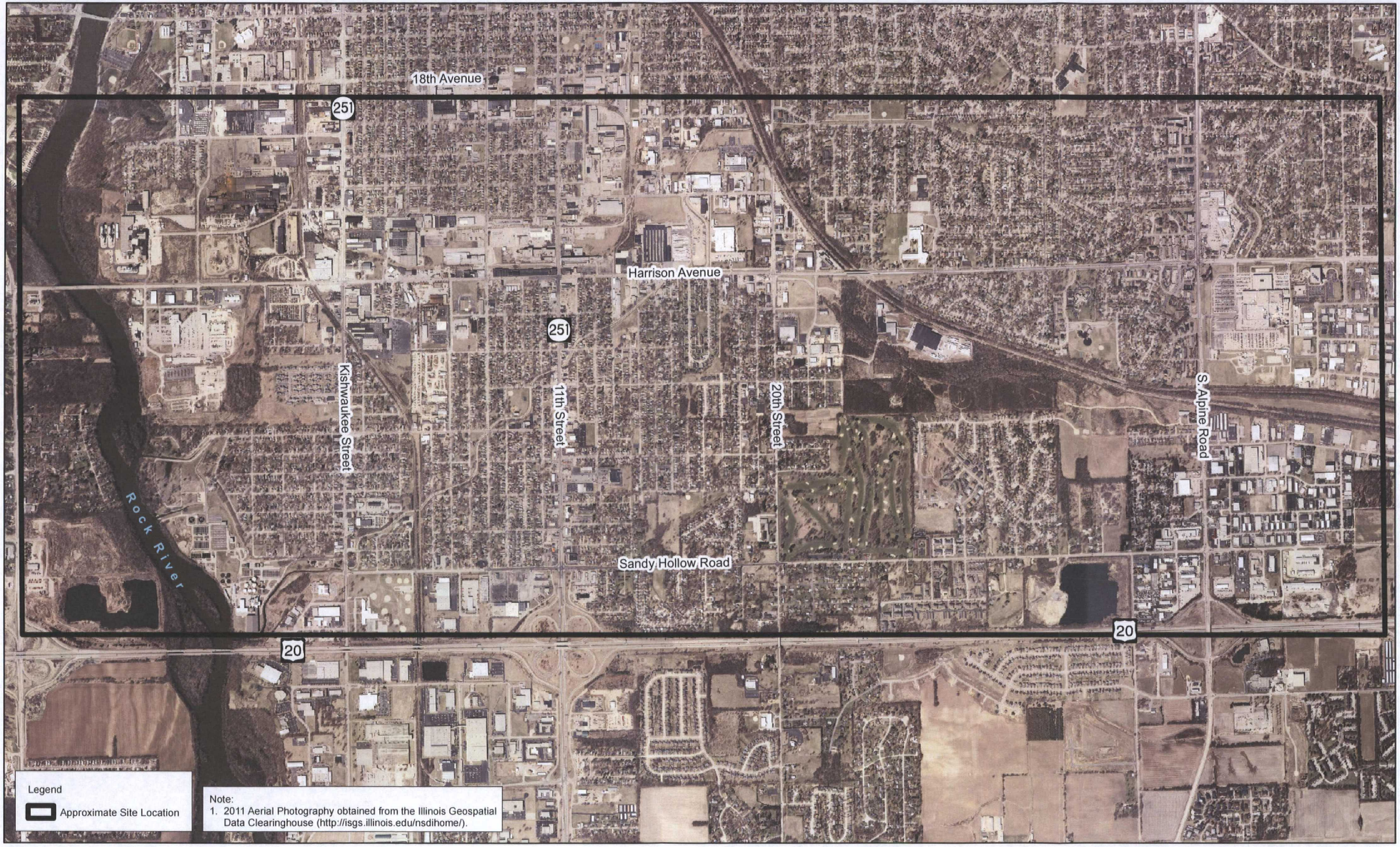

Figure 2
Site Area
Southeast Rockford Groundwater Contamination Site
Rockford, IL

CH2MHILL

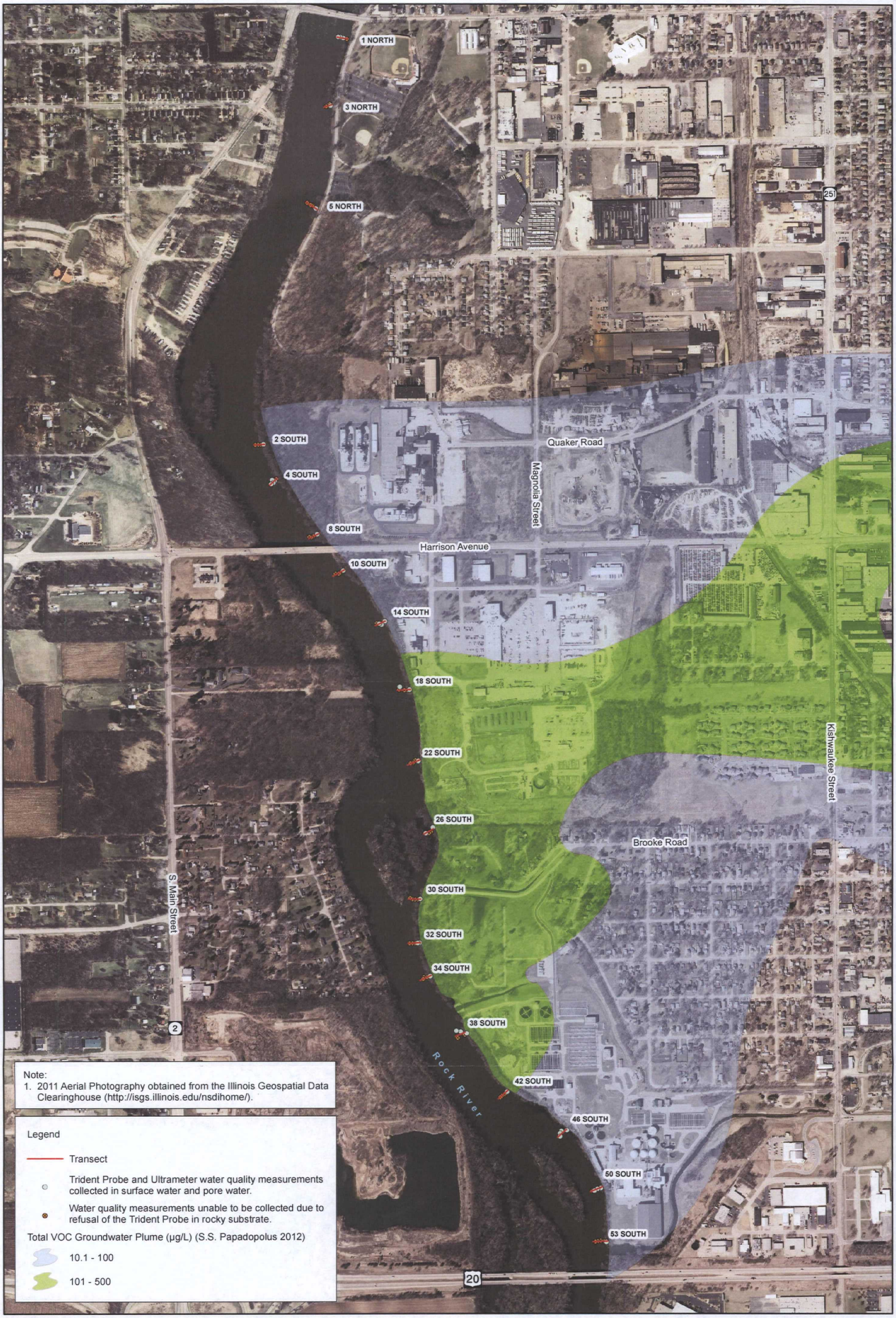

Figure 3
Pore Water Survey Transects
Southeast Rockford Groundwater Contamination Site
Rockford, IL

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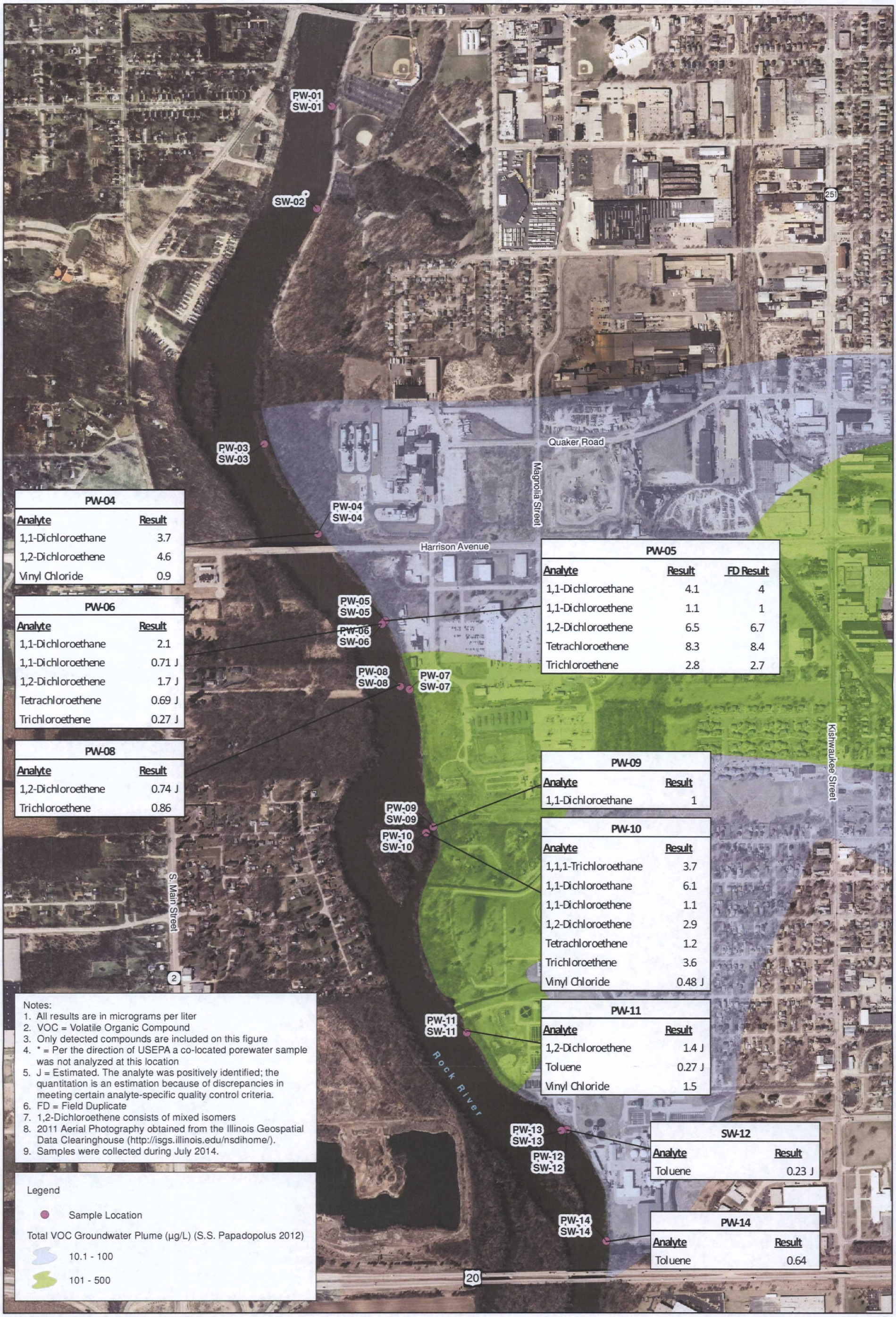

PW-04	
Analyte	Result
1,1-Dichloroethane	3.7
1,2-Dichloroethene	4.6
Vinyl Chloride	0.9

PW-06	
Analyte	Result
1,1-Dichloroethane	2.1
1,1-Dichloroethene	0.71 J
1,2-Dichloroethene	1.7 J
Tetrachloroethene	0.69 J
Trichloroethene	0.27 J

PW-08	
Analyte	Result
1,2-Dichloroethene	0.74 J
Trichloroethene	0.86

PW-05		
Analyte	Result	FD Result
1,1-Dichloroethane	4.1	4
1,1-Dichloroethene	1.1	1
1,2-Dichloroethene	6.5	6.7
Tetrachloroethene	8.3	8.4
Trichloroethene	2.8	2.7

PW-09	
Analyte	Result
1,1-Dichloroethane	1

PW-10	
Analyte	Result
1,1,1-Trichloroethane	3.7
1,1-Dichloroethane	6.1
1,1-Dichloroethene	1.1
1,2-Dichloroethene	2.9
Tetrachloroethene	1.2
Trichloroethene	3.6
Vinyl Chloride	0.48 J

PW-11	
Analyte	Result
1,2-Dichloroethene	1.4 J
Toluene	0.27 J
Vinyl Chloride	1.5

SW-12	
Analyte	Result
Toluene	0.23 J

PW-14	
Analyte	Result
Toluene	0.64

Notes:
1. All results are in micrograms per liter
2. VOC = Volatile Organic Compound
3. Only detected compounds are included on this figure
4. * = Per the direction of USEPA a co-located porewater sample was not analyzed at this location
5. J = Estimated. The analyte was positively identified; the quantitation is an estimation because of discrepancies in meeting certain analyte-specific quality control criteria.
6. FD = Field Duplicate
7. 1,2-Dichloroethene consists of mixed isomers
8. 2011 Aerial Photography obtained from the Illinois Geospatial Data Clearinghouse (http://isgs.illinois.edu/nsdihome/).
9. Samples were collected during July 2014.

Legend

Sample Location

Total VOC Groundwater Plume (µg/L) (S.S. Papadopolus 2012)

10.1 - 100

101 - 500

N

0 600 1,200

Feet

Figure 4
Detected Site-Specific VOCs
Southeast Rockford Groundwater Contamination Site
Rockford, IL

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Attachment 1
Coastal Monitoring Associates' Post-Pore-Water Survey and Sampling Summary Report

Draft Data Report

Southeast Rockford Groundwater Contamination Site - Groundwater Discharge to Surface Water Investigation

August 2014

Submitted to:

CH2M Hill

135 South 84th Street

Suite 400

Milwaukee, WI 53214

Submitted by:

Coastal Monitoring Associates, LLC

4741 Orchard Ave.

San Diego, CA 92107

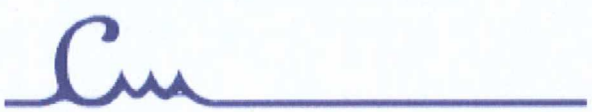


TABLE OF CONTENTS

LIST OF ACRONYMS

ags	Above Ground (Sediment) Surface
bgs	Below Ground (Sediment) Surface
C/T	Conductivity/Temperature
DGPS	Differential Global Positioning System
DLC	Data Logger/Controller Unit
NAD83	North American Datum 1983
NIST	National Institute of Standards and Technology
ORP	Oxidation-Reduction Potential
PARCC	Precision, Accuracy, Representativeness, Completeness, and/or Comparability
QA	Quality Assurance
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
TDS	Total Dissolved Solids
WAAS	Wide Area Augmentation System

UNITS

°C	degrees Celsius
ft	feet
%FS	percent full scale
µS/cm	microsiemens per centimeter
mS/cm	millisiemens per centimeter
ppm	parts-per-million
mv	millivolts
mls	milliliters
V	volts
cm	centimeters
m	meters
ml/min	milliliters per minute

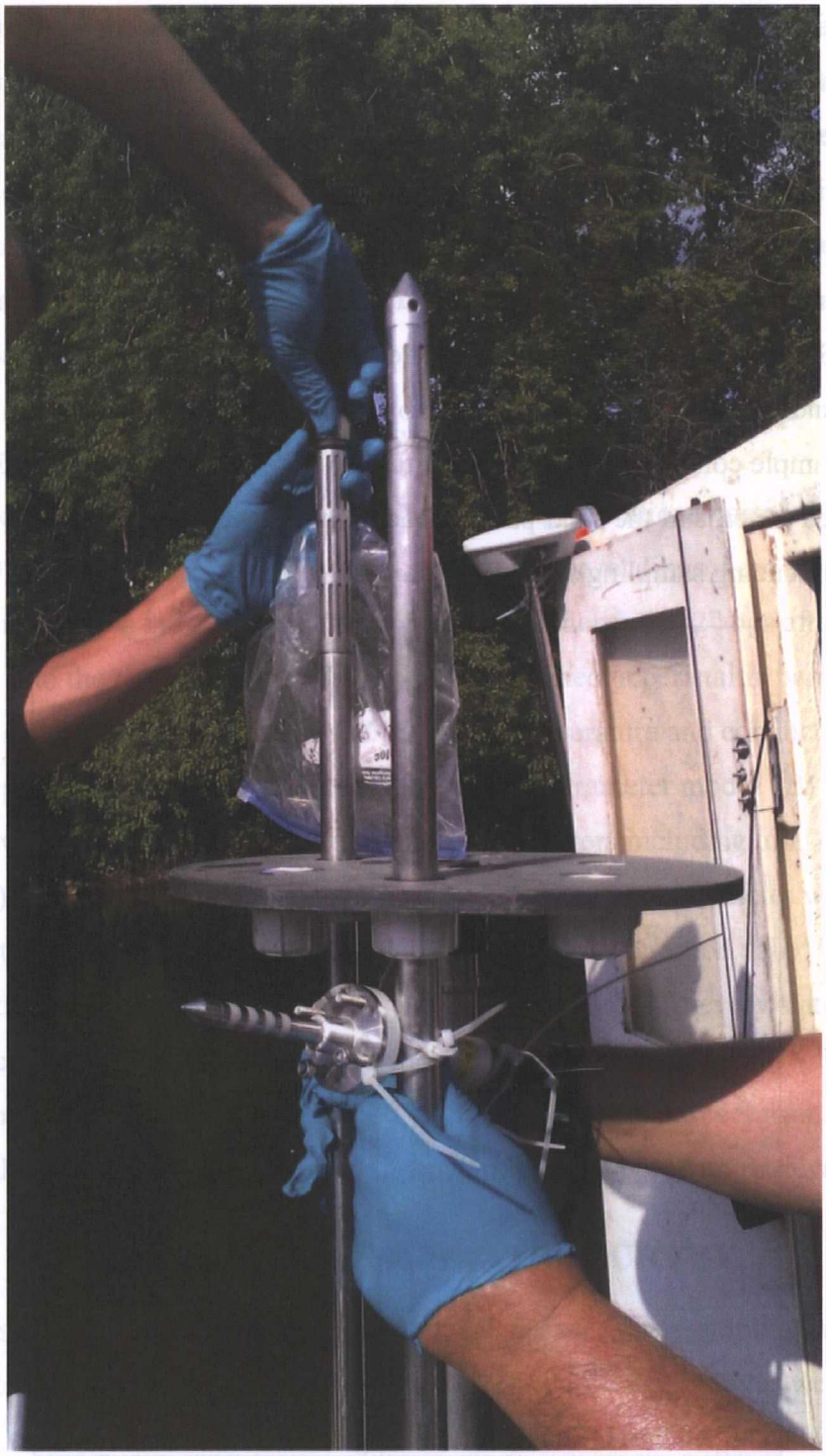


Figure 2-2. Actual configuration of the Trident Probe for the Rockford survey showing water sampling probe (behind on left), subsurface liquid-tip sensor probe (in front on right), and surface water sensor.

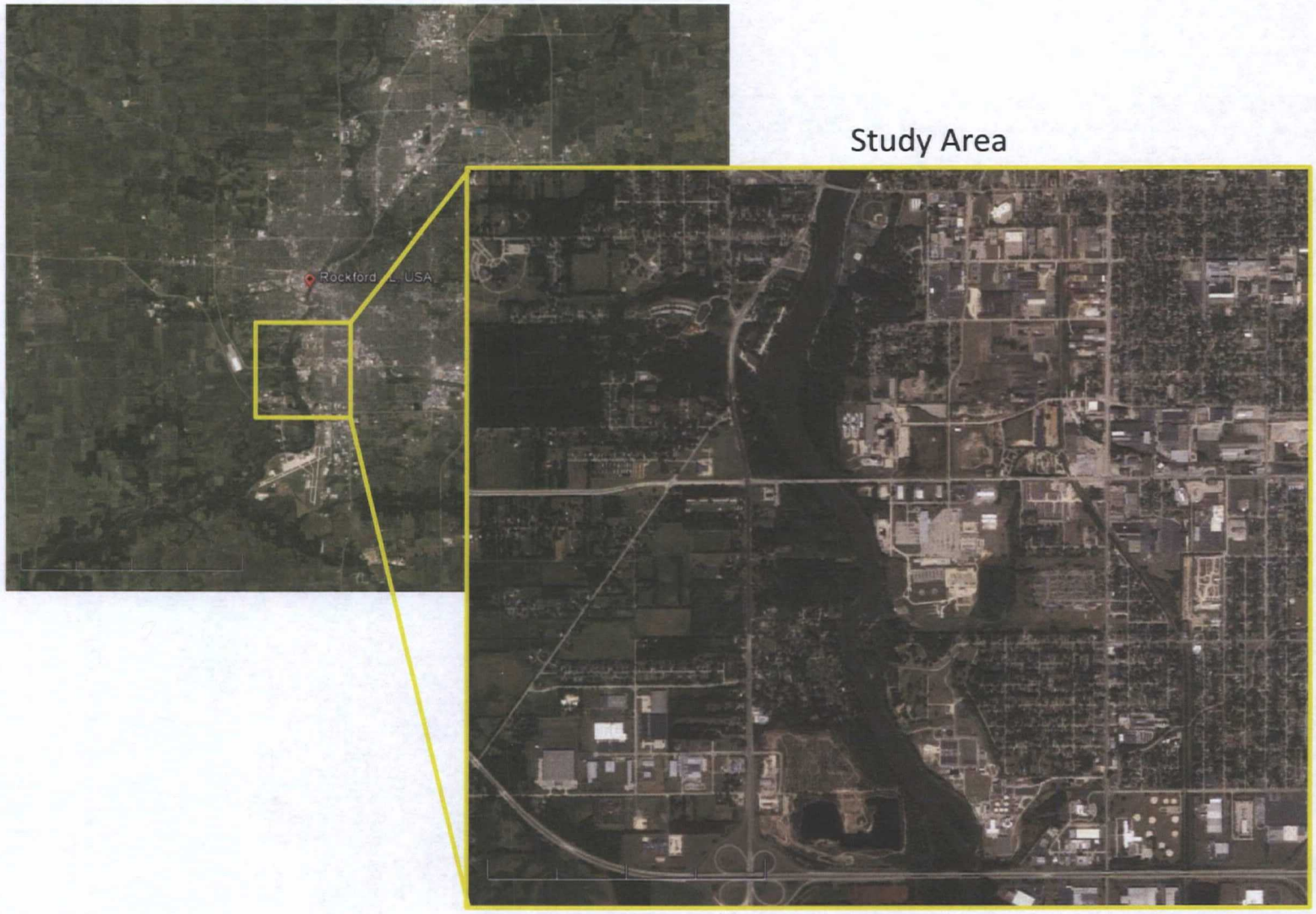


Figure 2-3. General study area vicinity in Rockford, Illinois for the Trident survey.

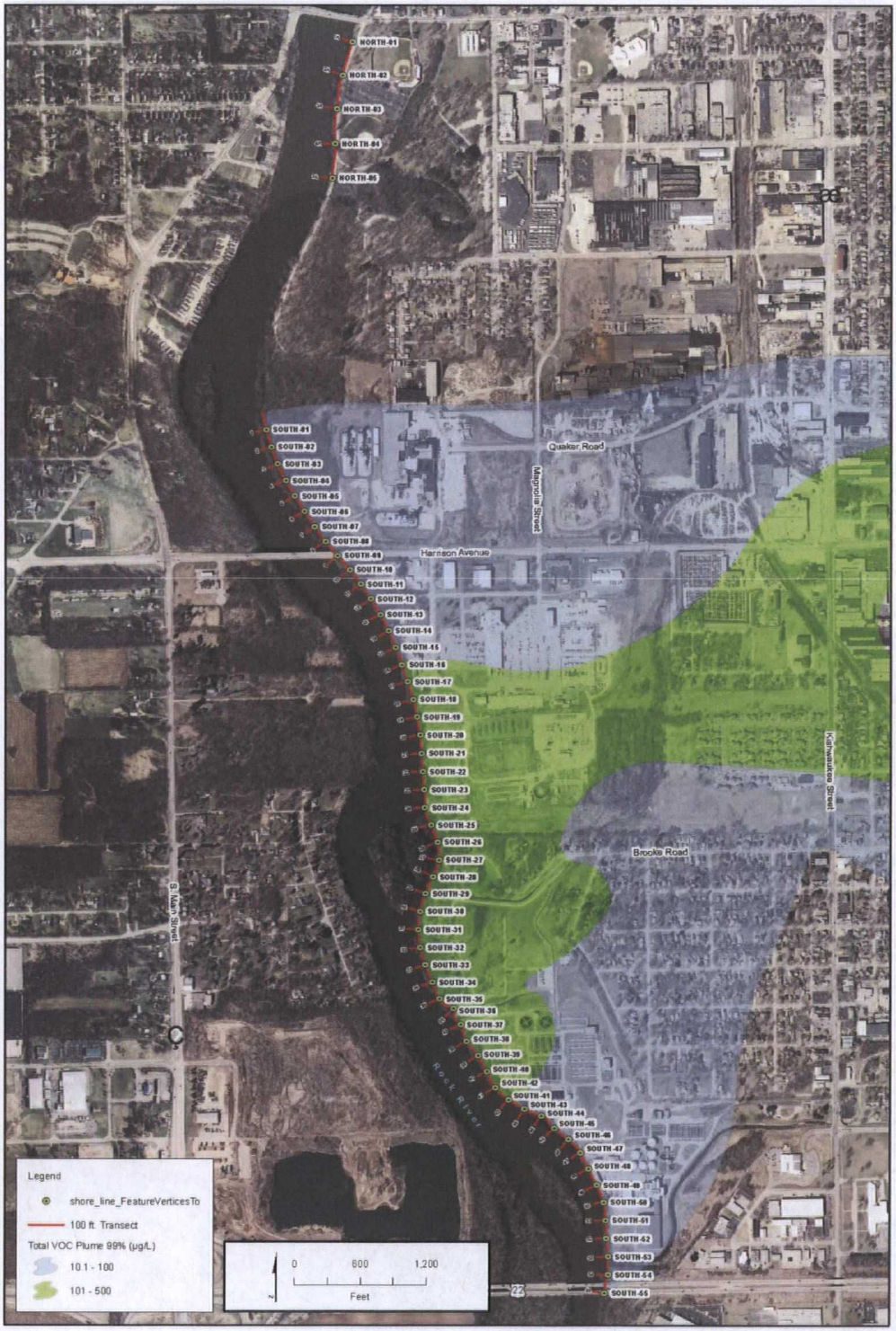


Figure 2-4. Target sampling stations for the Trident survey at the Rockford site. Labels indicate transect numbers and scale is in feet. Figure provided by CH2M Hill.

3 RESULTS

3.1 DATA QUALITY RESULTS

The quality assurance (QA) objective of this field investigation was to collect data of known and adequate quality to meet the project objectives. The QA processes included the application of: (1) appropriate field techniques; (2) appropriate analytical methods; and (3) measurement objectives for precision, accuracy, representativeness, completeness, and comparability (PARCC). Results for the QA objectives for the Trident measurements are summarized below.

3.1.1 TRIDENT DATA QUALITY

Precision

Precision for the Trident sensors including the subsurface temperature sensor, and the surface water temperature and conductivity sensors was assessed on the basis of replicate analysis performed under controlled laboratory conditions. Sensor replicates consisted of a minimum of six individual measurements for each standard. Results for the Trident laboratory precision were generated for replicate measurements of three separate National Institute of Standards and Technology (NIST) conductivity standards and three fixed temperature water baths monitored by a NIST thermometer. Laboratory relative standard deviations (RSDs) ranged from 0.02 – 0.04% of full scale for the Trident subsurface temperature sensor (Table 3-1) and from 0.01 – 0.02% of full scale for the surface water temperature sensor (Table 3-2).RSDs ranged from 0.0 – 1.5% of full scale for the Trident surface water conductivity sensor (Table 3-3) and from 0.0 – 0.0% of full scale for the surface water conductivity sensor (Table 3-4). These ranges of variation are generally 1-3 orders of magnitude lower than the variations observed at the site. Precision for the Myron model 6B meter used for the subsurface conductivity and additional water quality measurements in the field are shown in Table 3-5 based on the manufacturers specifications.

Accuracy

For Trident temperature and conductivity sensors, accuracy was established by applying laboratory calibrations. Calibration curves for the subsurface and surface water

temperature sensors are shown in Figure 3-1 and Figure 3-2. Calibration curves for the subsurface and surface water conductivity sensors are shown in Figure 3-3 and Figure 3-4. Based on the calibrations, accuracy (Relative Percent Difference [RPD]) averaged within <0.03% of full scale for the temperature sensors, and within <1.0% of full scale for the conductivity sensors. Accuracy for the Myron model 6B meter used for water quality measurements in the field are shown in (Table 3-5) based on the manufacturers specifications.

Representativeness

The representativeness is an expression of the degree to which sample data accurately represent the characteristics of a population, parameter variations at a sampling point, or an environmental condition that they are intended to represent. Representativeness was maximized by (1) selecting the appropriate number of samples and sampling locations, and (2) using appropriate and established sample collection, handling, and analysis techniques to provide information that reflects actual site conditions.

Representativeness for the Trident sensor sampling is limited to locations within the spatial and temporal domains of the study. Spatially, measurements were limited to the pre-designated sampling grid offshore from the Southeast Rockford Groundwater Contamination site and thus are only representative of this area. Further, measurements could not always be obtained in the rocky areas of the shoreline most often along the outer stations of the transects, and thus there was a limited amount of data to represent these areas. Vertically, the measurements are only representative of the shallow subsurface conditions at depths of 12 inches and the water column just above the sediment interface at a height of 4 inches. Temporally the data represent a snap shot in time limited to the period of data collection during mid-July 2014. Conditions are likely to vary seasonally and on other time scales.

Representativeness of porewater samples was evaluated by measuring water quality following the sample purge and at the conclusion of sample collection process. Water quality conditions representative of porewater generally reflect lower pH and/or ORP relative to surface water. Water quality measurements are presented and discussed in the field sampling results section below. Porewater samples were only collected at a subset of

locations on the sampling grid, and this selection process was based on the Trident sensor readings and other qualitative factors. The goal of the station selection was to sample at locations that showed the strongest indication of potential groundwater discharge (greatest differences in temperature and conductivity between surface water and porewater), and also provided some spatial diversity in the sampling area.

Completeness

Completeness assesses the amount of valid data obtained from a measurement system compared to the amount of data required to achieve a particular statistical level of confidence or in relation to the data required to achieve the project objectives. The percent completeness was calculated as the number of samples yielding acceptable data divided by the total number of samples planned to be collected and multiplied by 100. The total number of target stations was 240. Results for completeness were assessed for the Trident sensor data based on the number of stations where sampling was attempted. Sampling was attempted at a total of 92 target locations for a completeness of 38%. Of these 92 stations, acceptable data were obtained at a total of 37 stations. Of the remaining 203 target stations, 1 was in an inaccessible (probe refusal), and 148 were not visited because the sampling period of 5 days was insufficient. In addition to the sensor data, porewater and surface water samples were also collected. The project plan called for a total of 10 sample locations to be selected based on the sensor survey results. During the survey, this was expanded and a total of 13 porewater and 14 surface water samples were collected. Since this exceeds the target of 10, the completeness for the water sampling survey was >100%.

Comparability

Comparability is a qualitative parameter that expresses the degree of confidence that one data set may be compared to another. This goal was achieved through the use of (1) standardized techniques to collect and analyze samples, and (2) appropriate units to report analytical results. The comparability of the data was maximized by using standard analytical methods when possible, reporting data in consistent units, reporting data in a tabular format, and by validating the results against commonly accepted methodologies and target limits.

Temp Bath	Trident Probe - 1001				
(C)	Raw (C)	Cal (C)	Residual (C)	RPD (% FS)	RSD (% FS)
15.0	14.751	15.009	-0.009	0.03%	0.02%
15.0	14.740	14.998	0.002	0.01%	
15.0	14.746	15.004	-0.004	0.01%	
21.0	20.646	20.982	0.018	0.07%	0.04%
21.0	20.654	20.990	0.010	0.04%	
21.0	20.669	21.006	-0.006	0.02%	
27.0	26.590	27.005	-0.005	0.02%	0.04%
27.0	26.597	27.012	-0.012	0.05%	
27.0	26.578	26.993	0.007	0.03%	

Calibration Coefficients				
Slope	1.013	Min:	0.01%	0.02%
Offset	0.062	Max:	0.07%	0.04%
		Avg:	0.03%	0.03%
Full Scale	27.0			

Table 3-1. Temperature calibration results for the Trident subsurface (12") liquid-tip probe. Temperatures reported in degrees Celsius (C) and relative standard deviations and percent differences reported as percent of full scale (%FS).

Temp Bath	Trident Reference #1018				
(C)	Raw (C)	Cal (C)	Residual (C)	RPD (% FS)	RSD (% FS)
15.0	14.812	15.007	-0.007	0.02%	0.02%
15.0	14.807	15.002	-0.002	0.01%	
15.0	14.802	14.997	0.003	0.01%	
21.0	20.780	20.999	0.001	0.00%	0.01%
21.0	20.776	20.995	0.005	0.02%	
21.0	20.778	20.997	0.003	0.01%	
27.0	26.757	27.000	0.000	0.00%	0.01%
27.0	26.758	27.001	-0.001	0.00%	
27.0	26.761	27.004	-0.004	0.01%	

Calibration Coefficients				
Slope	1.004	Min:	0.00%	0.01%
Offset	0.135	Max:	0.02%	0.02%
		Avg:	0.01%	0.01%
Full Scale	27.0			

Table 3-2. Temperature calibration results for the Trident surface water probe. Temperatures reported in degrees Celsius (C) and relative standard deviations and percent differences reported as percent of full scale (%FS).

NIST Standard		Trident Probe - 1001				
Raw NIST (mS/cm)	Temp (C)	Raw Probe (mS/cm)	Cal Probe (mS/cm)	Residual (mS/cm)	RPD (% FS)	RSD (% FS)
0.084	25.808	0.161	0.105	-0.021	0.3%	0.0%
0.084	25.797	0.159	0.104	-0.020	0.3%	
0.084	25.801	0.158	0.103	-0.019	0.3%	
1.413	26.808	2.271	1.482	-0.069	1.0%	0.1%
1.413	26.838	2.281	1.488	-0.075	1.1%	
1.413	26.921	2.288	1.493	-0.080	1.1%	
7	26.563	10.570	6.896	0.104	1.5%	1.5%
7	26.587	10.653	6.950	0.050	0.7%	
7	26.63	10.888	7.103	-0.103	1.5%	
Calibration Coefficients				Min	0.3%	0.0%
Slope	0.652			Max	1.5%	1.5%
				Avg	0.9%	0.5%
Full Scale	7					

Table 3-3. Conductivity calibration results for the Trident subsurface (12") liquid-tip probe. Conductivities reported in millisiemens per centimeter (mS/cm) and relative standard deviations reported as percent of full scale (%FS).

NIST Standard		Trident Reference #1018				
Raw NIST (mS/cm)	Temp (C)	Raw Ref (mS/cm)	Cal Ref (mS/cm)	Residual (mS/cm)	RPD (% FS)	StDev Res (mS/cm)
0.084	26.151	0.149	0.089	-0.005	0.1%	0.0%
0.084	26.183	0.149	0.089	-0.005	0.1%	
0.084	26.214	0.149	0.089	-0.005	0.1%	
1.413	27.614	2.380	1.414	-0.001	0.0%	0.0%
1.413	27.625	2.379	1.413	0.000	0.0%	
1.413	27.664	2.376	1.412	0.001	0.0%	
7	26.828	11.785	7.002	-0.002	0.0%	0.0%
7	26.843	11.785	7.002	-0.002	0.0%	
7	28.831	11.777	6.997	0.003	0.0%	
Calibration Coefficients				Min	0.0%	0.0%
Slope	0.594			Max	0.1%	0.0%
				Avg	0.0%	0.0%
Full Scale	7					

Table 3-4. Conductivity calibration results for the Trident surface water probe. Conductivities reported in millisiemens per centimeter (mS/cm) and relative standard deviations reported as percent of full scale (%FS).

Sensor	Range	Precision	Accuracy
Temperature	32 - 160 °F	0.1 °F	± 0.1 °F
Conductivity	0 - 9999 µS/cm	0.01 (<100 µS/cm)	± 1% of reading
	10 - 200 mS/cm	0.1 (<1 mS/cm)	
	5 Autoranges	1.0 (>1 mS/cm)	
TDS	0 - 9999 ppm	0.01 (<100 ppm)	± 1% of reading
	10 - 200 ppt	0.1 (<1 ppt)	
	5 Autoranges	1.0 (>1 ppt)	
pH	0 - 14	0.01	0.01
ORP	± 999 mV	± 1 mV	± 1 mV

Table 3-5. Specifications for the Myron model 6B water quality meter.

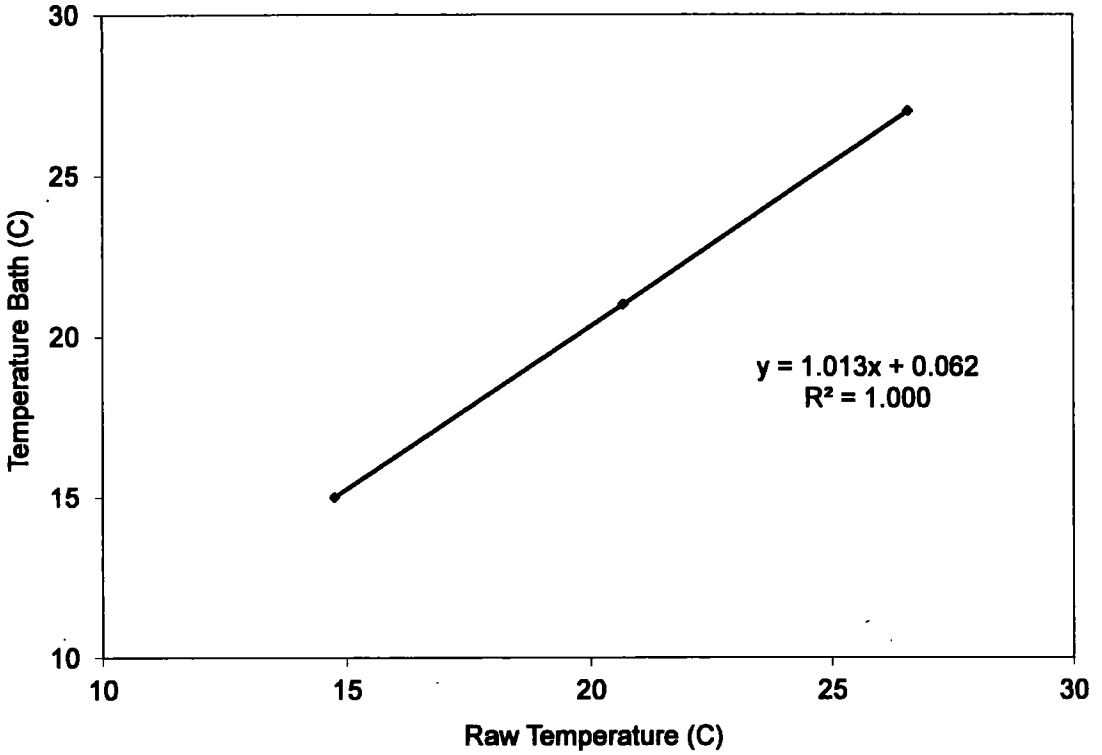


Figure 3-1. Trident subsurface (12") liquid tip temperature sensor calibration.

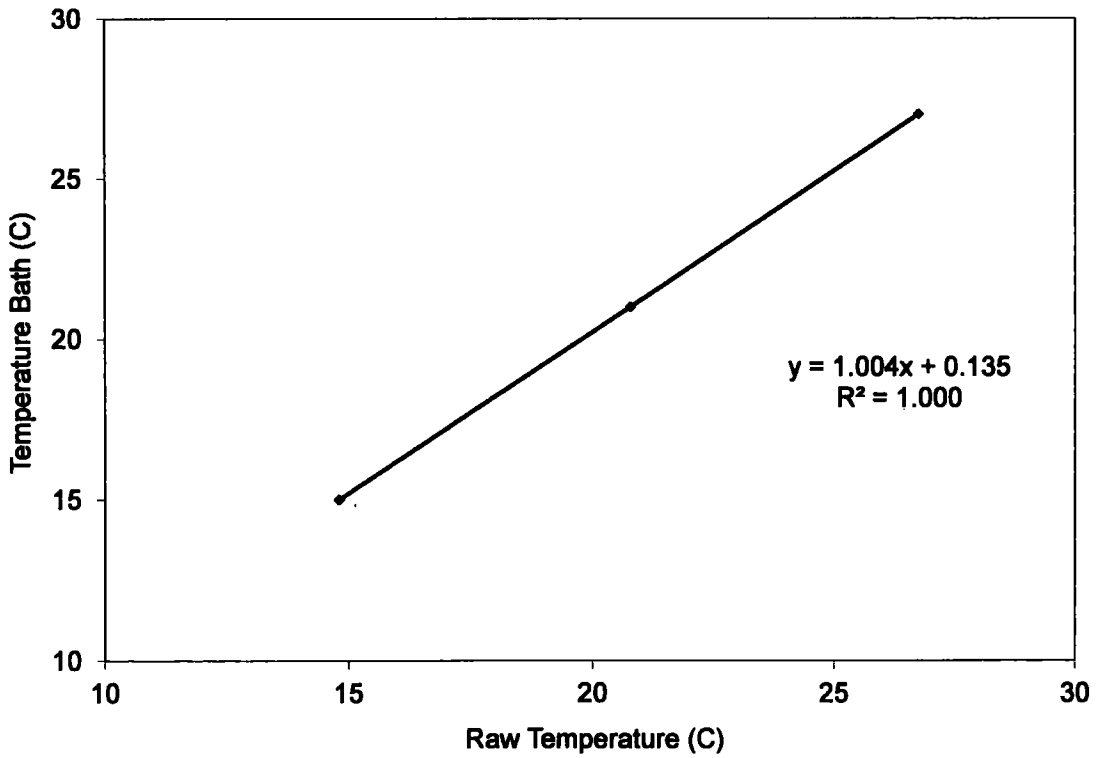


Figure 3-2. Trident surface water temperature sensor calibration.

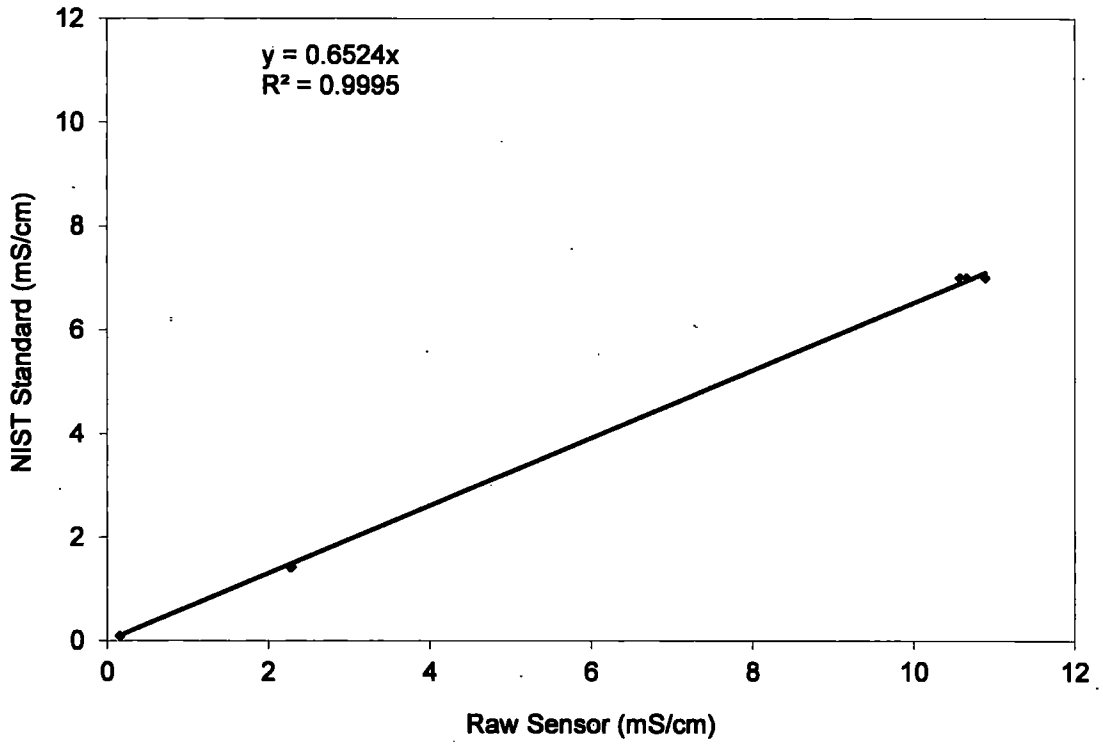


Figure 3-3. Trident subsurface (12") liquid tip conductivity sensor calibration.

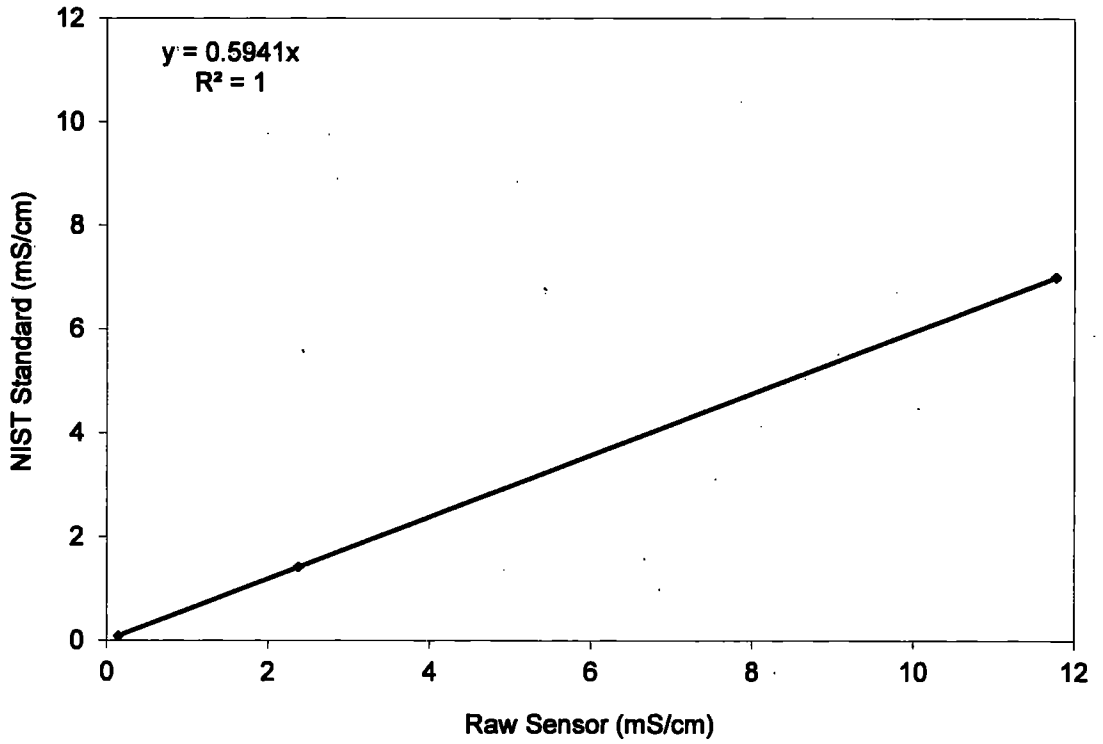


Figure 3-4. Trident surface water conductivity sensor calibration.

3.2 FIELD SAMPLING RESULTS

3.2.1 TRIDENT SENSOR SURVEY

Trident sensor readings were successfully collected at 37 stations (Figure 3-5). Temperature and conductivity sensor readings were recorded for surface water at 4" ags, and at a subsurface depth of 12" bgs. Sensor readings for each station are shown in Table 3-6 and provided in tabular form in the electronic data deliverable file "Rockford Trident Survey EDD 080614.xlsx." Results are summarized below for the in-situ Trident temperature sensor measurements and the small volume Myron meter conductivity measurements. Trident liquid-tip conductivity measurements are included in the electronic deliverable and correlated closely to the Myron meter measurements at most stations.

Surface Water Sensors (4" ags)

Surface water temperatures ranged from 21.073 to 24.023 °C with the lowest reading at station SOUTH-46-25, the highest at station SOUTH-4-50a, and an overall average of 22.553 °C. The range of surface water temperatures at the site was fairly narrow, spanning ~2-3 °C, Surface water did not show a clear trend along the river, though there was a weak trend toward warmer temperatures at the shallower stations near the shoreline. Surface water conductivities ranged from about 588.2 to 953 µS/cm with the lowest conductivity at station SOUTH-18-7, the highest at station SOUTH-45-50, and an overall average of 627.8 µS/cm. Surface water conductivities were fairly uniform across the study area with the majority of stations in the range of 600-700 µS/cm with selected stations showing higher conductivities in the south.

Subsurface Sensors (12" bgs)

Trident subsurface temperatures ranged from 18.711 to 23.378 °C with the lowest reading at station SOUTH-14-25, the highest at station NORTH-1-50, and an overall average of 21.577 °C. Shallow subsurface temperatures were consistently lower than surface water temperatures across the site (37 of 37 stations). Subsurface temperatures did not show a significant trend along river, but as with surface water showed a weak trend toward warmer temperatures in shallower water. Shallow subsurface conductivities ranged from

about 573.9 to 2428 µS/cm with the lowest conductivity at station SOUTH-50-50, the highest at station SOUTH-53-5, and an average of 981 µS/cm. Subsurface conductivities were generally higher than surface water conductivities across the site (33 of 37 stations).

Porewater vs. Surface Water Conductivity and Temperature Contrast

The temperature and conductivity contrast between surface water and subsurface porewater was used as an indicator of potential groundwater discharge zones. At many fresh water sites, long residence times and interaction of ground water with subsurface soils results in conductivities higher than those observed in surface waters. During summer months, differential heating of surface water and groundwater tends to lead to cooler temperatures in groundwater. Thus stations with subsurface conductivity elevated relative to surface water and/or subsurface temperatures cooler than surface water were considered to be potentially influenced by groundwater discharge.

Conductivity contrast (calculated as the surface water conductivity from the Myron meter subtracted from the porewater conductivity from the Myron meter) ranged from a low of -72.7 µS/cm at station SOUTH-50-50 to a high of 1770.5 µS/cm at station SOUTH-53-5, where positive values indicate porewater greater than surface water consistent with potential groundwater discharge. Areas of highest conductivity contrast were concentrated in the central and southern portions of the site especially closer to shore (Figure 3-6).

The magnitude of temperature contrast (calculated as the surface water temperature from the in situ Trident sensor subtracted from the porewater temperature from the Trident sensor) ranged from a high of -3548 °C at station SOUTH-14-25 to a low of -0.061 °C at station SOUTH-46-25, where negative values indicate porewater less than surface water consistent with potential groundwater discharge. Areas of highest temperature contrast were concentrated in the central portion of the site (Figure 3-7).

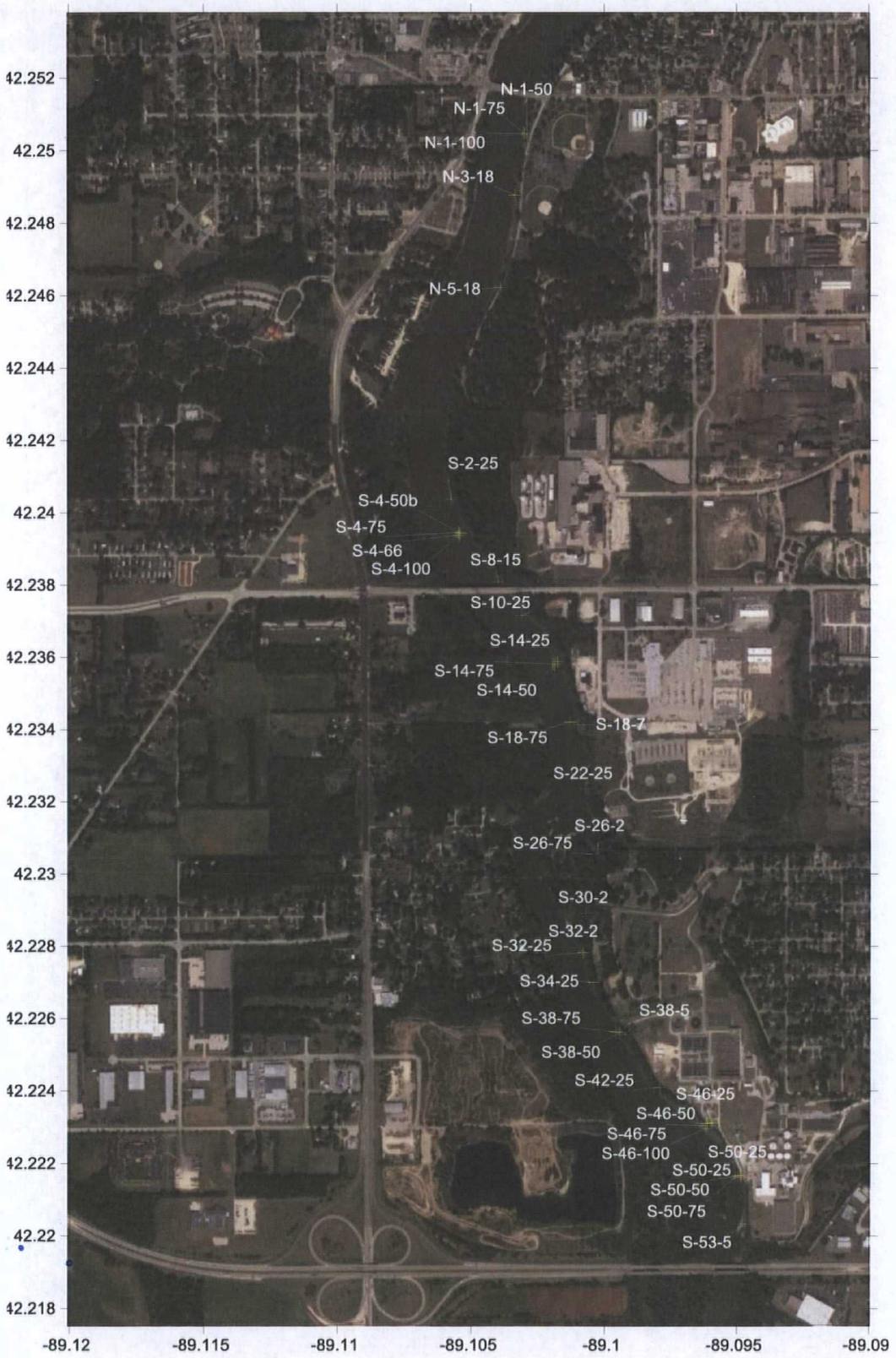


Figure 3-5. Locations of the Trident sensor survey stations.

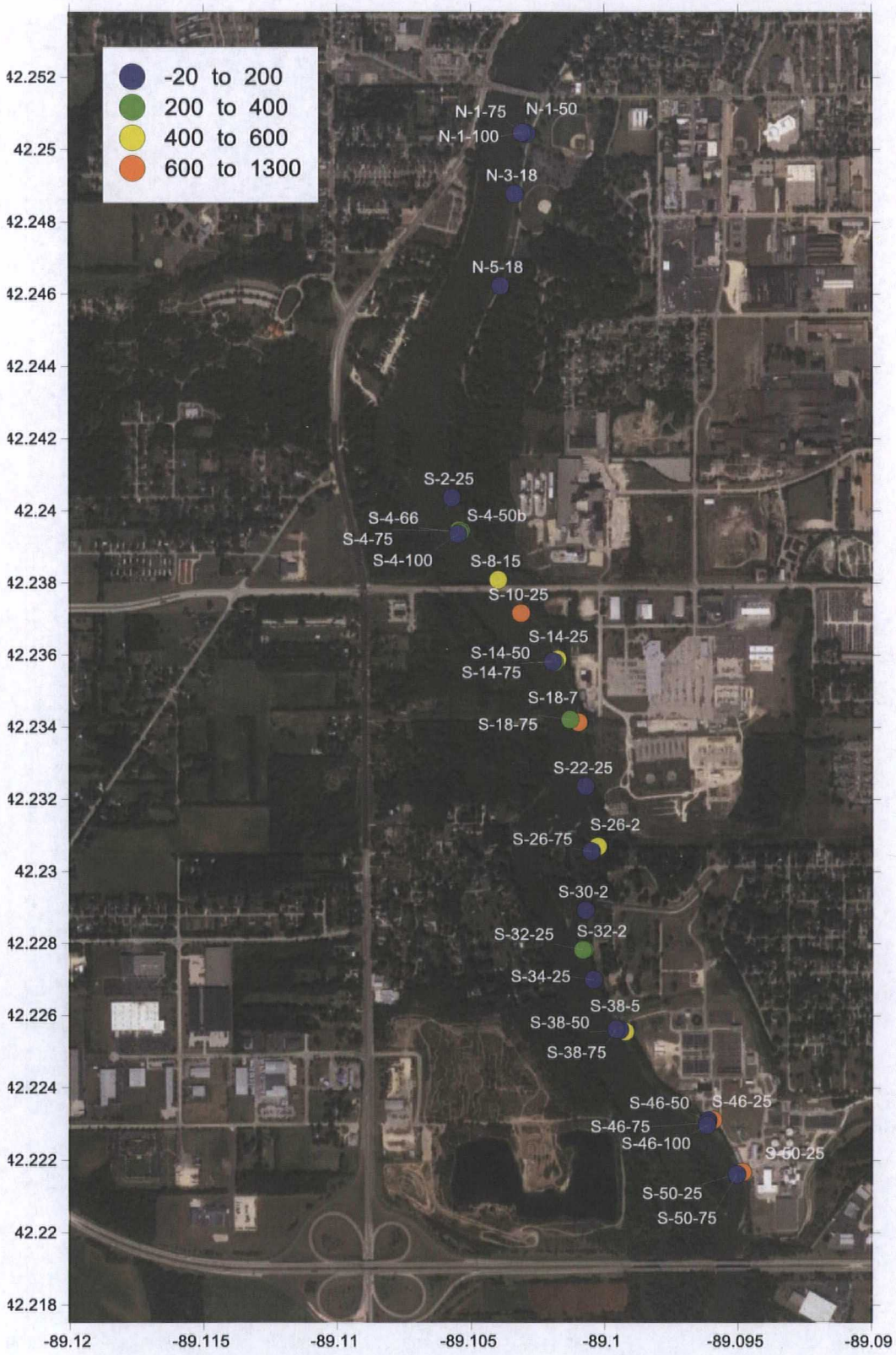


Figure 3-6. Spatial distribution of conductivity contrast (μS/cm).

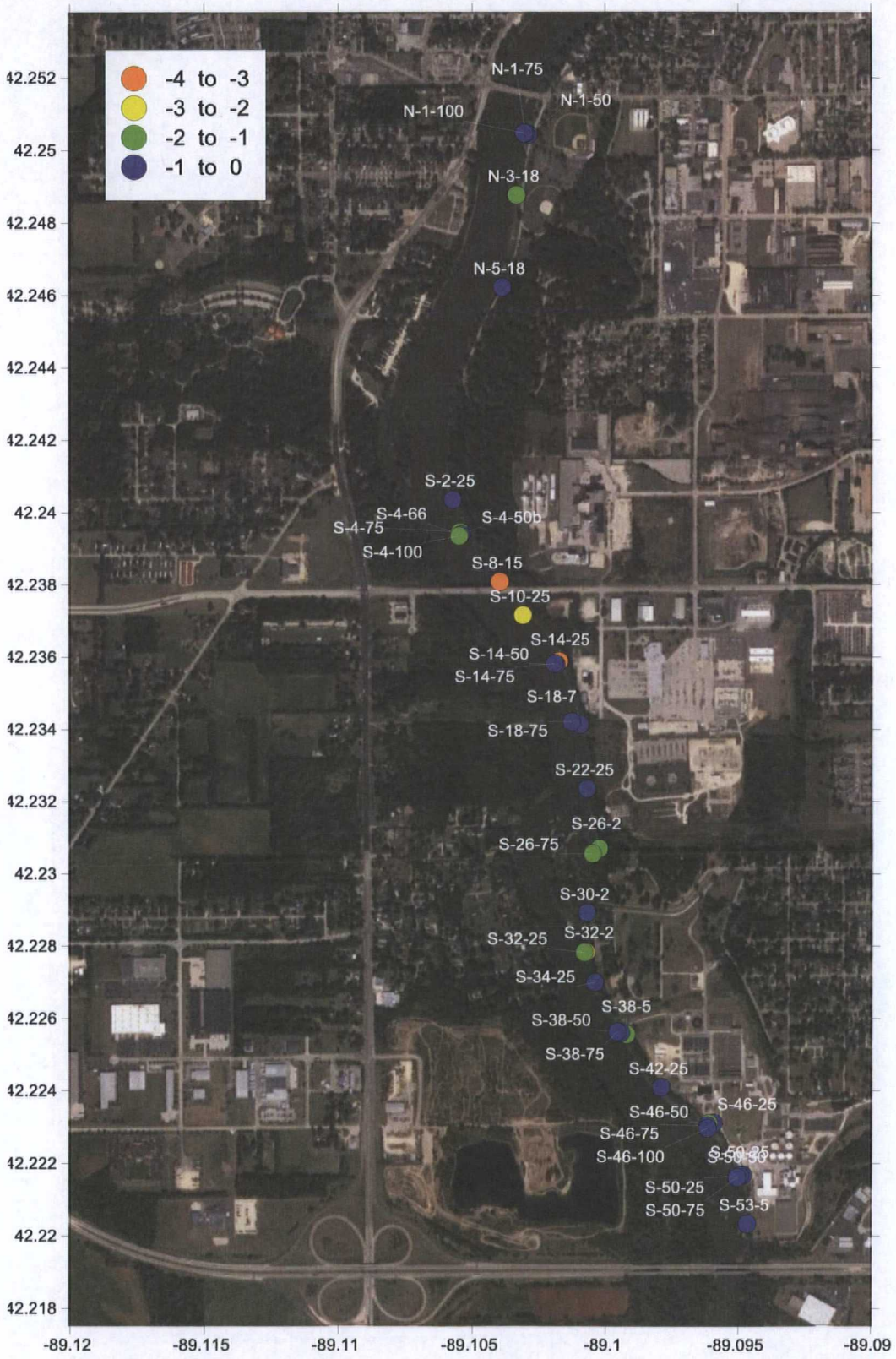


Figure 3-7. Spatial distribution of temperature contrast (°C).

Transect	Area	Date-Time	Distance from Shore (feet)	Lat (degrees N NAD83)	Long (degrees W NAD83)	GPS Acc. (cm)	Medium	Water Column Depth (feet)	Measurements							Field Notes	
									Trident Probe		Ultrameter						
									Cond (uS/cm)	Temp (°C)	Cond (uS/cm)	Temp (°C)	pH	ORP (mV)	TDS (mg/L)	Sediment Type	General Comments
1	Reference (North)	7/14/14 13:45	25	NR	NR	NR	SW	--	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/14/14 11:55	50	42.2504400	89.1029108	65	SW	5.4	600	23.557	594.2	25.2	7.95	227	270.8	Rocky	Trident plate ~2" ags
							PW		756	23.378	627.4	25.7	7.99	202	291.5		
		7/14/14 10:00	75	42.2504700	89.1030081	68	SW	5.9	597	23.302	672.4	23.8	7.95	235	322	Rocky	12" achieved
							PW		773	23.042	729.8	24.1	7.85	202	352.9		
		7/14/14 10:38	100	42.2504703	89.1030769	66	SW	NR	598	23.372	592.2	24.1	8.01	177	270.5	Rocky	High cond w/ bouce back to SW conditions
							PW		1209	22.990	790.2	24.2	7.72	172	383.0		
3	Reference (North)	7/17/14 12:00	18	42.2487708	89.1033567	81	SW	2.7	610	21.748	672.5	24.2	7.99	164	312.5	Clay	12" achieved; 2-probe configuration
							PW		766	20.573	675.7	23.6	7.33	-24	322.4		
		7/17/14 12:25	25	42.2487758	89.1033878	68	SW	3.3	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/17/14 12:30	50	42.2487514	89.1034961	54	SW	4.2	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/17/14 12:35	75	42.2487639	89.1033583	54	SW	4.9	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/17/14 12:40	100	42.2488069	89.1033822	52	SW	5.8	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
5	Reference (North)	7/17/14 21:30	18	42.2462283	89.1038928	120	SW	1.2	608	21.486	604.8	21.0	7.68	177	279	Clay	12" achieved; 2-probe configuration
							PW		771	21.398	774.8	20.8	7.04	-79	376.5		
		7/17/14 10:10	25	42.2462506	89.1039200	79	SW	3.5	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/17/14 10:15	50	42.2463044	89.1040064	67	SW	4.2	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/17/14 10:20	75	42.2463189	89.1040603	67	SW	4.5	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/17/14 10:25	100	42.2463733	89.1041744	68	SW	5.1	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
2	Plume (South)	7/15/14 14:35	25	42.2403631	89.1057353	120	SW	4.0	601	22.662	593.3	20.1	8.12	169	272.5	Sand w/ rocks underneath	12" achieved; 2-probe configuration
							PW		984	21.788	792.5	19.7	7.03	-77	385.3		
		7/15/14 15:10	50	42.2403533	89.1058339	120	SW	5.5	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/15/14 15:15	75	42.2403553	89.1059125	150	SW	5.6	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/15/14 15:20	100	42.2403503	89.1060031	110	SW	5.6	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		

Table 3-6. Trident sensor and water quality results for surface water and subsurface porewater at each station.

Transect	Area	Date-Time	Distance from Shore (feet)	Lat (degrees N NAD83)	Long (degrees W NAD83)	GPS Acc. (cm)	Medium	Water Column Depth (feet)	Measurements							Field Notes	
									Trident Probe[1]		Ultrameter					Sediment Type	General Comments
									Cond (uS/cm)	Temp (°C)	Cond (uS/cm)	Temp (°C)	pH	ORP (mV)	TDS (mg/L)		
4	Plume (South)	7/14/14 16:15	25	NR	NR	NR	SW	NR	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/14/14 15:15	50a	NR	NR	NR	SW	5.5	602	24.023	597.3	25.4	7.99	196	272.4	Hard sand, with softer layer beneath	12" achieved; poor yield (no Ultrameter readings on PW)
							PW		982	22.452	--	--	--	--	--		
		7/14/14 15:45	50b	42.2394347	89.1053775	110	SW	5.7	601	22.939	597.7	23.7	7.99	202	272.3	Rocky surface, sandy beneath	10" achieved
							PW		983	22.578	841.6	23.3	7.43	200	409.3		
		7/18/14 9:00	66	42.2394589	89.1054656	140	SW	5.2	610	21.636	604.4	20	8.14	218	278.8	Sandy with rocks	12" achieved; 2-probe configuration
							PW		1108	21.182	897.5	20.1	7.31	213	484.3		
		7/14/14 14:50	75	42.2393892	89.1054247	110	SW	6.1	599	23.990	596.8	25.0	8.10	160	274.4	Rocky with some sand	12" achieved
							PW		982	22.612	967.1	25.6	7.27	171	471.5		
		7/14/14 14:25	100	42.2393508	89.1054981	60	SW	6.3	600	23.924	593.3	24.7	7.91	210	270.6	Rocky with some sand	Trident plate ~2" ags
							PW		630	22.897	593.7	24.3	7.71	197	270.0		
8	Plume (South)	7/15/14 13:00	15	42.2380847	89.1039817	52	SW	4.2	605	22.452	623.3	19.9	8.1	151	290.9	Sandy mud	12" achieved; 2-probe configuration
							PW		1114	19.437	1053	19.1	7.02	0	518.2		
		7/15/14 13:30	50	42.2380289	89.1041147	76	SW	NR	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/15/14 13:35	75	42.2380064	89.1041906	58	SW	6.1	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/15/14 13:40	100	42.2380192	89.1042483	74	SW	6.5	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
10	Plume (South)	7/15/14 11:00	25	42.2371608	89.1031303	71	SW	3.9	601	22.325	593.8	19.1	7.84	224	278.2	Soft sand	12" achieved; 2-probe configuration
							PW		2148	19.98	1862	17.5	7.2	-44	931.8		
		7/15/14 11:40	50	42.2371211	89.1032114	59	SW	5.8	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/15/14 11:45	75	42.2370883	89.1032792	58	SW	6.0	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/15/14 11:50	100	42.2370853	89.1033811	58	SW	6.6	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
14	Plume (South)	7/18/14 12:45	25	42.2358803	89.1017694	150	SW	4.8	600	22.259	590	18.1	8.17	153	270.2	Sandy	12" achieved
							PW		1315	18.711	1185	16.6	7.15	166	585.8		
		7/15/14 10:10	50	42.2358428	89.1018608	68	SW	NR	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/15/14 10:15	75	42.2358233	89.1019403	67	SW	NR	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/15/14 10:20	100	42.2358339	89.1020417	67	SW	NR	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/18/14 17:45	50	42.2357933	89.1018797	120	SW	5.5	613	22.885	608.5	24.8	8.19	216	280.1	Rocky	only 6-8" achieved after hammering; 1-probe configuration
							PW		1271	22.441	850.2	26.1	7.37	211	398.7		
		7/18/14 17:15	75	42.2358175	89.1019508	60	SW	5.5	613	22.868	626.3	26.4	8.17	204	290.2	Rocky	only 6-8" achieved after hammering; just did parameters
							PW		1170	22.543	776.6	25.9	7.6	196	375.8		

Table 3 6. (cont.)

Transect	Area	Date-Time	Distance from Shore (feet)	Lat (degrees N NAD83)	Long (degrees W NAD83)	GPS Acc. (cm)	Medium	Water Column Depth (feet)	Measurements							Field Notes	
									Trident Probe[1]		Ultrameter					Sediment Type	General Comments
									Cond (uS/cm)	Temp (°C)	Cond (uS/cm)	Temp (°C)	pH	ORP (mV)	TDS (mg/L)		
18	Plume (South)	7/15/14 9:15	7	42.2341328	89.1009814	120	SW	2.3	596	21.289	588.2	17.9	7.98	211	269.2	Rocks with sand on top; hard clay about	12" achieved; 2-probe configuration
							PW		1265	21.193	1190	17.8	7.01	-57	587.7		
		7/15/14 10:05	25	42.2341189	89.1010342	120	SW	3.2	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/15/14 10:10	50	42.2341181	89.1011458	67	SW	6.2	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/15/14 10:20	75	42.2341319	89.1012369	67	SW	7.0	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/15/14 10:25	100	42.2341289	89.1013217	67	SW	8.0	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/18/14 15:55	75	42.2342089	89.1012992	130	SW	8.4	612	22.836	606.3	26.4	8.29	153	277.7	Rocky	12" acheieved after hammering; 2-probe configuration
							PW		1421	22.248	969.4	25.7	7.9	148	471.8		
22	Plume (South)	7/16/14 11:15	25	42.2323597	89.1007161	65	SW	4.5	594	21.72	589.1	19.6	8.05	169	269.9	Gravelly sand	12" achieved; 2-probe configuration
							PW		726	21.33	625.8	19.8	8.13	154	292.2		
		7/16/14 12:00	50	42.2323675	89.1008042	57	SW	5.6	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/16/14 12:05	75	42.2323031	89.1008969	89	SW	6.3	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/16/14 12:10	100	42.2322983	89.1009639	89	SW	6.8	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
26	Plume (South) - island back channel area	7/16/14 14:30	2	42.2306953	89.1002567	120	SW	1.8	588	22.48	618.7	26.6	7.4	236	287.2	Hard clay	12" achieved; 2-probe configuration
							PW		753	20.709	1027	24.7	7.2	212	502.2		
		7/16/14 12:40	25	42.2305892	89.1003172	79	SW	5.0	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/16/14 12:45	50	42.2305633	89.1003917	89	SW	4.4	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/16/14 13:20	75	42.2305531	89.1005014	120	SW	3.3	595	22.074	588.7	22	8.11	155	268.6	Clayey with a little sand	12" achieved; 2-probe configuration
							PW		815	21.064	724.8	22.2	8.09	163	350.7		
			100	NA	NA	NA	SW	NA	NA	NA	NA	NA	NA	NA	NA	--	Inaccessible
							PW		NA	NA	NA	NA	NA	NA	NA		
30	Plume (South)	7/16/14 16:15	2	42.2289197	89.1007089	120	SW	2.0	598	22.543	616.5	23.8	7.92	211	284.9	Hard Clay	12" achieved; 2-probe configuration
							PW		850	21.546	597	23.7	8.33	177	273.2		
		7/16/14 16:55	25	42.2289067	89.1007883	83	SW	5.0	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/16/14 17:00	50	42.2289094	89.1008828	92	SW	5.2	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/16/14 17:05	75	42.2289225	89.1009669	63	SW	5.4	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/16/14 17:10	100	42.2289481	89.1010442	63	SW	5.5	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		

Table 3 6. (cont.)

Transect	Area	Date-Time	Distance from Shore (feet)	Lat (degrees N NAD83)	Long (degrees W NAD83)	GPS Acc. (cm)	Medium	Water Column Depth (feet)	Measurements							Field Notes	
									Trident Probe[1]		Ultrameter					Sediment Type	General Comments
									Cond (uS/cm)	Temp (°C)	Cond (uS/cm)	Temp (°C)	pH	ORP (mV)	TDS (mg/L)		
32	Plume (South)	7/14/14 18:05	2	42.2278283	89.1007558	83	SW	3.0	601	23.935	592.9	23.3	8.02	165	270.8	Silty, mud/clay w/sandy	Achieved 12"
							PW		1077	21.370	923.0	23.3	7.07	-121	450.8		
		7/14/14 17:35	25	42.2278239	89.1008128	66	SW	4.6	602	23.932	596.5	23.7	7.90	191	273.7	Sandy	Achieved 12" with 1-probe configuration
							PW		864	22.316	797.5	23.6	7.14	-13	386.7		
		7/14/14 17:30	50	NR	NR	NR	SW	NR	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/14/14 17:00	75	NR	NR	NR	SW	NR	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/14/14 17:25	100	NR	NR	NR	SW	NR	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
34	Plume (South)	7/16/14 18:00	25	42.2269967	89.1004139	74	SW	3.9	598	22.45	597.2	22.4	7.94	212	273.7	Rocky on top, soft clay shallow and	12" achieved; 2-probe configuration
							PW		737	21.575	684.5	22.5	7.41	-4	328.1		
		7/16/14 18:30	50	42.2269761	89.1005206	60	SW	5.7	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/16/14 18:35	75	42.2269769	89.1006258	54	SW	6.7	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/16/14 18:40	100	42.2269317	89.1006472	60	SW	7.1	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
38	Plume (South)	7/16/14 19:15	5	42.2255606	89.0992267	76	SW	1.9	599	22.292	594.7	21.6	7.78	206	280.8	Rocky sand with clay underneath	12" achieved; 2-probe configuration
							PW		756	21.214	1158.0	22	6.82	-66	569.8		
		7/16/14 18:50	25	42.2255325	89.0992850	84	SW	4.3	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/16/14 19:50	50	42.2254889	89.0994014	82	SW	5.8	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/16/14 19:55	75	42.2254686	89.0994336	82	SW	6.2	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/16/14 20:00	100	42.2254506	89.0995247	82	SW	6.3	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/18/14 14:55	50	42.2256083	89.0994289	120	SW	4.7	613	22.872	607.4	24.4	8.15	195	281.8	Slight sand over rock	12" acheieved after hammering; 2-probe configuration
							PW		697	21.935	598.3	24.7	7.68	182	273.6		
		7/18/14 14:05	75	42.2256283	89.0995708	59	SW	5.1	612	22.627	609.1	25.1	8.18	189	281.9	Rocky	12" acheieved after hammering; 2-probe configuration
							PW		737	21.735	637.2	24.8	7.65	181	297.8		
42	Plume (South)	7/17/14 13:40	25	42.2240981	89.0979103	59	SW	3.1	608	22.221	607.9	26	8.13	138	279	clay with silt	12" achieved; 2-probe configuration
							PW		2501	21.911	2222	25.5	6.83	-144	1112		
		7/17/14 14:20	50	42.2240303	89.0979947	58	SW	6.4	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/17/14 14:25	75	42.2239892	89.0980858	58	SW	7.2	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/17/14 14:30	100	42.2239564	89.0981311	57	SW	7.2	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		

Table 3 6. (cont.)

Transect	Area	Date-Time	Distance from Shore (feet)	Lat (degrees N NAD83)	Long (degrees W NAD83)	GPS Acc. (cm)	Medium	Water Column Depth (feet)	Measurements							Field Notes	
									Trident Probe[1]		Ultrameter						
									Cond (uS/cm)	Temp (°C)	Cond (uS/cm)	Temp (°C)	pH	ORP (mV)	TDS (mg/L)	Sediment Type	General Comments
46	Plume (South)	7/17/14 15:10	25	42.2231169	89.0959328	91	SW	2.1	861	21.073	845.4	25.9	7.78	153	410	Sandy clay	12" acheieved; 2-probe configuration
							PW		1664	21.012	1485	25.9	6.77	73	733.2		
		7/17/14 15:55	50	42.2231014	89.0961192	70	SW	3.2	1019	22.38	953	25.9	7.75	199	464.9	Sandy clay	12" acheieved; 2-probe configuration
							PW		1417	20.829	1120	25.2	6.94	-139	548.3		
		7/17/14 16:45	75	42.2230411	89.0961619	63	SW	5.1	608	22.507	609.2	24.3	7.73	211	297.8	Sand	12" acheieved; 2-probe configuration
							PW		701	21.64	635.8	24.7	7.26	-114	297.2		
		7/17/14 17:35	100	42.2229714	89.0961617	1.1	SW	7.3	608	22.372	608.7	24.2	7.94	193	280.2	Sand with rock	12" acheieved; 2-probe configuration
							PW		717	22.095	602.8	24.0	7.77	181	279.8		
50	Plume (South)	7/18/14 11:25	25	42.2216803	89.0948281	60	SW	3.6	670	21.922	664.7	23.8	7.88	179	315.3	Gravelly	12" achieved; 2-probe configuration
							PW		2212	21.372	1135	24.1	6.91	-113	556.7		
		7/18/14 12:40	25	42.2216753	89.0948311	56	SW	3.2	670	22.22	664.7	24.7	8.1	133	315.1	Gravel above sand	12" achieved; 2-probe configuration
							PW		11650	21.359	1939	24.8	6.89	-134	964.4		
		7/18/14 11:45	50	42.2216592	89.0949475	58	SW	6.0	655	22.006	646.6	23.7	8.28	99	304	Rocky with sand underneath	12" achieved; 2-probe configuration
							PW		677	21.373	573.9	24.4	7.19	-104	258.4		
		7/18/14 12:00	75	42.2216131	89.0950433	56	SW	7.4	616	22.214	631.9	24	8.13	179	294.7	Rocky with sand underneath	12" achieved; 2-probe configuration
							PW		1022	21.467	805.6	24.5	7.13	-114	392.3		
		7/18/14 12:10	100	42.2216175	89.0951028	56	SW	8.4	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
53	Plume (South)	7/18/14 10:20	5	42.2203408	89.0946672	130	SW	1.5	644	21.638	657.5	21.6	7.77	230	311.5	Hard Clay	12" acheieved; 2-probe configuration
							PW		2686	20.644	2428	21.8	6.82	-110	1221		
		7/18/14 10:05	25	42.2203553	89.0947406	67	SW	3.0	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/18/14 10:50	50	42.2203731	89.0948583	57	SW	2.2	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/18/14 10:55	75	42.2203600	89.0949603	56	SW	3.4	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		
		7/18/14 11:00	100	42.2203503	89.0950364	55	SW	4.3	R	R	R	R	R	R	R	Rocky	Refusal
							PW		R	R	R	R	R	R	R		

Table 3 6. (cont.)

3.2.2 TRIDENT WATER QUALITY

Ancillary water quality measurements for porewater and surface water were successfully collected at 37 stations. Ancillary water quality parameters including TDS (calculated from conductivity), pH, and ORP were measured for surface water at 4" ags, and at a subsurface depth of 12" bgs using the Myron meter. Water quality results for each station are shown in Table 3-6 and are provided in tabular form in the electronic data deliverable file "Rockford Trident Survey EDD 080614.xlsx." The water quality results were recorded at the end of the purge period for the Trident sensor readings. Results are summarized below.

Surface Water Quality (4" ags)

Surface water TDS ranged from 268.6 to 464.9 ppm with an overall average of 292.1 ppm. TDS in the Myron is calculated directly from conductivity and thus followed the same trends as described above. Surface water ORP ranged from 99 to 236 mv with the lowest reading at station SOUTH-50-50, the highest reading at station SOUTH-26-2, and an overall average of 186.6 mv. All stations all had positive ORP >99 mv consistent with expectations for surface water. Surface water pH ranged from 7.40 to 8.29 with the lowest reading at station SOUTH-26-2, the highest reading at station SOUTH-18-75, and an overall average of 7.99. This range is generally consistent with expectations for surface water in riverine systems.

Subsurface Porewater Quality (12" bgs)

Subsurface TDS ranged from 258.4 to 1221 ppt with an overall average of 478.5 ppm. TDS in the Myron is calculated directly from conductivity and thus followed the same trends as described above. Subsurface ORP ranged from -144 to 213 mv with the lowest reading at station SOUTH-42-25, the highest reading at station SOUTH-4-66, and an overall average of 52 mv. About half of the stations had negative ORPs consistent with reducing porewater conditions. The remainder had positive ORPs consistent with more oxidizing conditions likely as a result of the rocky substrate and lack of significant accumulation of organic matter. Subsurface water pH ranged from 6.77 to 8.33 with the lowest reading at station SOUTH-46-25, the highest reading at station SOUTH-30-2, and an overall average of 7.35. On average, subsurface pH was lower than surface water and

the majority (34 of 37) stations had lower pH in the shallow subsurface porewater than in the surface water.

3.2.3 TRIDENT POREWATER AND SURFACE WATER SAMPLING

Porewater samples were successfully collected at a total of 13 target stations (NORTH-03-18, SOUTH-02-25, SOUTH-08-15, SOUTH-14-25, SOUTH-14-50, SOUTH-18-7, SOUTH-18-75, SOUTH-26-2, SOUTH-26-75, SOUTH-38-5, SOUTH-46-25, SOUTH-46-50, SOUTH-53-5), and surface water samples were collected at 14 target stations (same as porewater station plus North-05-18). Results for the porewater sampling are shown in Table 3-7 and Figure 3-8.

Transect	Area	Date-Time	Distance from Shore (feet)	Lat (degrees N NAD83)	Long (degrees W NAD83)	GPS Acc. (cm)	Medium	Sample Volume (ml)
3	Reference (North)	7/17/14 12:00	18	42.2487708	89.1033567	81	SW	370
							PW	370
5	Reference (North)	7/17/14 21:30	18	42.2462283	89.1038928	120	SW	370
							PW	NS
2	Plume (South)	7/15/14 14:35	25	42.2403631	89.1057353	120	SW	370
							PW	370
8	Plume (South)	7/15/14 13:00	15	42.2380847	89.1039817	52	SW	370
							PW	370
14	Plume (South)	7/18/14 12:45	25	42.2358803	89.1017694	150	SW	740*
							PW	740*
		7/18/14 17:45	50	42.2357933	89.1018797	120	SW	370
							PW	370
18	Plume (South)	7/15/14 9:15	7	42.2341328	89.1009814	120	SW	1110**
							PW	1110**
		7/18/14 15:55	75	42.2342089	89.1012992	130	SW	370
							PW	370
26	Plume (South) - island back channel area	7/16/14 14:30	2	42.2306953	89.1002567	120	SW	370
							PW	370
		7/16/14 13:20	75	42.2305531	89.1005014	120	SW	370
							PW	370
38	Plume (South)	7/16/14 19:15	5	42.2255606	89.0992267	76	SW	370
							PW	370
46	Plume (South)	7/17/14 15:10	25	42.2231169	89.0959328	91	SW	370
							PW	370
		7/17/14 15:55	50	42.2231014	89.0961192	70	SW	370
							PW	370
53	Plume (South)	7/18/14 10:20	5	42.2203408	89.0946672	130	SW	370
							PW	370

*Doulbe volume for field duplicate station
**Triple volume for MS/MSD station

Table 3-7. Water sampling results.

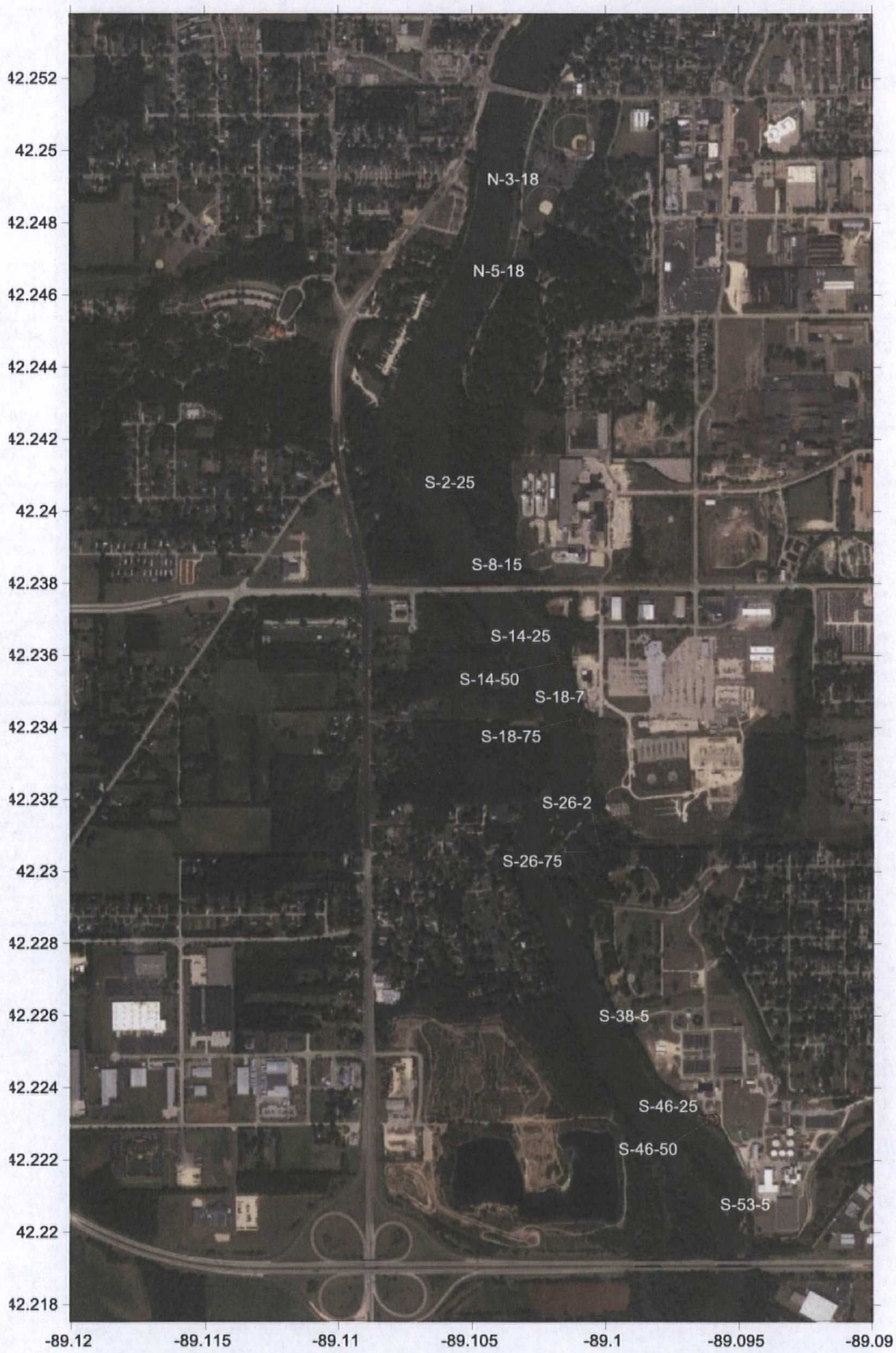


Figure 3-8. Location of water sampling stations.

4 REFERENCES

Chadwick, D.B., J. Groves, C. Smith, and R. Paulsen. 2003. Hardware description and sampling protocols for the Trident Probe and UltraSeep system: Technologies to evaluate contaminant transfer between groundwater and surface water. Technical Report #1902, SSC San Diego, United States Navy.

Chadwick, B. and A. Hawkins, 2008. Monitoring of Water and Contaminant Migration at the Groundwater–Surface Water Interface (ER200422) - Final Report, SPAWAR Systems Center San Diego Technical Report 1967.

Paulsen, R.J., C. F. Smith, D. O'Rourke and T. Wong, 2001. Development and Evaluation of an Ultrasonic Groundwater Seepage Meter, Ground Water Nov-Dec 2001, 904-911.

Transect	Area	Date-Time	Distance from Shore (feet)	Lat (degrees N NAD83)	Long (degrees W NAD83)	GPS Acc. (cm)	Medium	Water Column Depth (feet)	Measurements							Differentials							Field Notes		
									Trident Probe		Ultrameter					Trident Probe		Ultrameter							
									Cond (uS/cm)	Temp (°C)	Cond (uS/cm)	Temp (°C)	pH	ORP (mV)	TDS (mg/L)	Cond (uS/cm)	Temp (°C)	Cond (uS/cm)	Temp (°C)	pH	ORP (mV)	TDS (mg/L)	Sediment Type	Water Sample	General Comments
1	Reference (North)	7/14/14 13:45	25	NR	NR	NR	SW	--	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/14/14 11:55	50	42.2504400	89.1029108	65	SW	5.4	600	23.557	594.2	25.2	7.95	227	270.8								Rocky		Trident plate ~2" ags
							PW		756	23.378	627.4	25.7	7.99	202	291.5	156	-0.179	33.2	0.5	0.04	-25	20.7		
		7/14/14 10:00	75	42.2504700	89.1030081	68	SW	5.9	597	23.302	672.4	23.8	7.95	235	322								Rocky		12" achieved
							PW		773	23.042	729.8	24.1	7.85	202	352.9	176	-0.26	57.4	0.3	-0.1	-33	30.9		
		7/14/14 10:38	100	42.2504703	89.1030769	66	SW	NR	598	23.372	592.2	24.1	8.01	177	270.5								Rocky		High cond w/ bouce back to SW conditions
							PW		1209	22.990	790.2	24.2	7.72	172	383.0	611	-0.382	198	0.1	-0.29	-5	112.5		
3	Reference (North)	7/17/14 12:00	18	42.2487708	89.1033567	81	SW	2.7	610	21.748	672.5	24.2	7.99	164	312.5								Clay	Surface and Porewater	12" achieved; 2-probe configuration
							PW		766	20.573	675.7	23.6	7.33	-24	322.4	156	-1.175	3.2	-0.6	-0.66	-188	9.9		
		7/17/14 12:25	25	42.2487758	89.1033878	68	SW	3.3	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/17/14 12:30	50	42.2487514	89.1034961	54	SW	4.2	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/17/14 12:35	75	42.2487639	89.1033583	54	SW	4.9	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/17/14 12:40	100	42.2488069	89.1033822	52	SW	5.8	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
5	Reference (North)	7/17/14 21:30	18	42.2462283	89.1038928	120	SW	1.2	608	21.486	604.8	21.0	7.68	177	279								Clay	Surface water only	12" achieved; 2-probe configuration
							PW		771	21.398	774.8	20.8	7.04	-79	376.5	163	-0.088	170	-0.2	-0.64	-256	97.5		
		7/17/14 10:10	25	42.2462506	89.1039200	79	SW	3.5	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/17/14 10:15	50	42.2463044	89.1040064	67	SW	4.2	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/17/14 10:20	75	42.2463189	89.1040603	67	SW	4.5	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/17/14 10:25	100	42.2463733	89.1041744	68	SW	5.1	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
2	Plume (South)	7/15/14 14:35	25	42.2403631	89.1057353	120	SW	4.0	601	22.662	593.3	20.1	8.12	169	272.5								Sand w/ rocks underneath	Surface and Porewater	12" achieved; 2-probe configuration
							PW		984	21.788	792.5	19.7	7.03	-77	385.3	383	-0.874	199.2	-0.4	-1.09	-246	112.8		
		7/15/14 15:10	50	42.2403533	89.1058339	120	SW	5.5	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/15/14 15:15	75	42.2403553	89.1059125	150	SW	5.6	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/15/14 15:20	100	42.2403503	89.1060031	110	SW	5.6	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
4	Plume (South)	7/14/14 16:15	25	NR	NR	NR	SW	NR	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/14/14 15:15	50a	NR	NR	NR	SW	5.5	602	24.023	597.3	25.4	7.99	196	272.4								Hard sand, with softer layer beneath		12" achieved; poor yield (no Ultrameter readings on PW)
							PW		982	22.452	--	--	--	--	--	380	-1.571	--	--	--	--	--			
		7/14/14 15:45	50b	42.2394347	89.1053775	110	SW	5.7	601	22.939	597.7	23.7	7.99	202	272.3								Rocky surface, sandy beneath		10" achieved
							PW		983	22.578	841.6	23.3	7.43	200	409.3	382	-0.361	243.9	-0.4	-0.56	-2	137		
		7/18/14 9:00	66	42.2394589	89.1054656	140	SW	5.2	610	21.636	604.4	20	8.14	218	278.8								Sandy with rocks		12" achieved; 2-probe configuration
							PW		1108	21.182	897.5	20.1	7.31	213	484.3	498	-0.454	293.1	0.1	-0.83	-5	205.5		
		7/14/14 14:50	75	42.2393892	89.1054247	110	SW	6.1	599	23.990	596.8	25.0	8.10	160	274.4								Rocky with some sand		12" achieved
							PW		982	22.612	967.1	25.6	7.27	171	471.5	383	-1.378	370.3	0.6	-0.83	11	197.1		
		7/14/14 14:25	100	42.2393508	89.1054981	60	SW	6.3	600	23.924	593.3	24.7	7.91	210	270.6								Rocky with some sand		Trident plate ~2" ags
							PW		630	22.897	593.7	24.3	7.71	197	270.0	30	-1.027	0.4	-0.4	-0.2	-13	-0.6		
8	Plume (South)	7/15/14 13:00	15	42.2380847	89.1039817	52	SW	4.2	605	22.452	623.3	19.9	8.1	151	290.9								Sandy mud	Surface and Porewater	12" achieved; 2-probe configuration
							PW		1114	19.437	1053	19.1	7.02	0	518.2	509	-3.015	429.7	-0.8	-1.08	-151	227.3		
		7/15/14 13:30	50	42.2380289	89.1041147	76	SW	NR	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/15/14 13:35	75	42.2380064	89.1041906	58	SW	6.1	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/15/14 13:40	100	42.2380192	89.1042483	74	SW	6.5	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
10	Plume (South)	7/15/14 11:00	25	42.2371608	89.1031303	71	SW	3.9	601	22.325	593.8	19.1	7.84	224	278.2								Soft sand		12" achieved; 2-probe configuration
							PW		2148	19.98	1862	17.5	7.2	-44	931.8	1547	-2.345	1268.2	-1.6	-0.64	-268	653.6		
		7/15/14 11:40	50	42.2371211	89.1032114	59	SW	5.8	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/15/14 11:45	75	42.2370883	89.1032792	58	SW	6.0	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/15/14 11:50	100	42.2370853	89.1033811	58	SW	6.6	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
14	Plume (South)	7/18/14 12:45	25	42.2358803	89.1017694	150	SW	4.8	600	22.259	590	18.1	8.17	153	270.2								Sandy	Surface and Porewater	12" achieved
							PW		1315	18.711	1185	16.6	7.15	166	585.8	715	-3.548	595	-1.5	-1.02	13	315.6		
		7/15/14 10:10	50	42.2358428	89.1018608	68	SW	NR	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/15/14 10:15	75	42.2358233	89.1019403	67	SW	NR	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/15/14 10:20	100	42.2358339	89.1020417	67	SW	NR	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/18/14 17:45	50	42.2357933	89.1018797	120	SW	5.5	613	22.885	608.5	24.8	8.19	216	280.1								Rocky	Surface and Porewater	only 6-8" achieved after hammering; 1-probe configuration
							PW		1271	22.441	850.2	26.1	7.37	211	398.7	658	-0.444	241.7	1.3	-0.82	-5	118.6		
		7/18/14 17:15	75	42.2358175	89.1019508	60	SW	5.5	613	22.868	626.3	26.4	8.17	204	290.2								Rocky		only 6-8" achieved after hammering; just did parameters
							PW		1170	22.543	776.6	25.9	7.6	196	375.8	557	-0.325	150.3	-0.5	-0.57	-8	85.6		

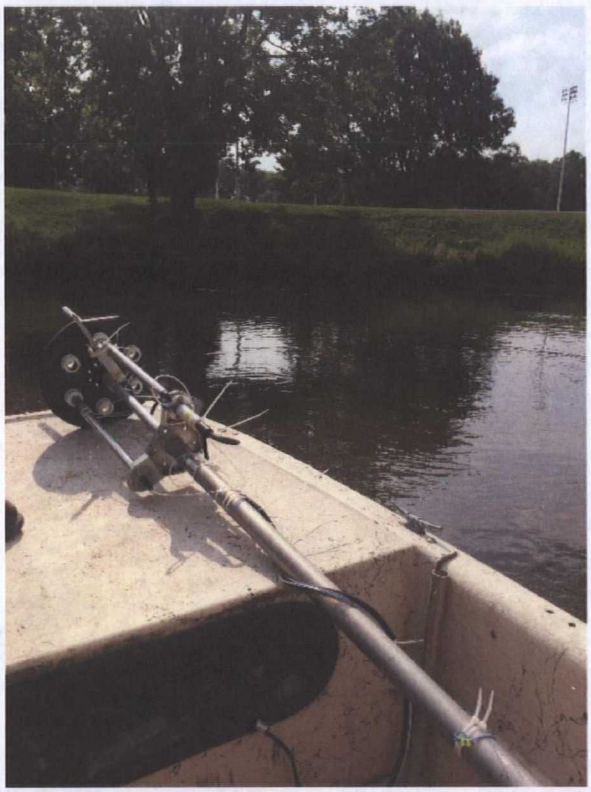
Transect	Area	Date-Time	Distance from Shore (feet)	Lat (degrees N NAD83)	Long (degrees W NAD83)	GPS Acc. (cm)	Medium	Water Column Depth (feet)	Measurements							Differentials							Field Notes		
									Trident Probe		Ultrameter					Trident Probe		Ultrameter							
									Cond (uS/cm)	Temp (°C)	Cond (uS/cm)	Temp (°C)	pH	ORP (mV)	TDS (mg/L)	Cond (uS/cm)	Temp (°C)	Cond (uS/cm)	Temp (°C)	pH	ORP (mV)	TDS (mg/L)	Sediment Type	Water Sample	General Comments
18	Plume (South)	7/15/14 9:15	7	42.2341328	89.1009814	120	SW	2.3	596	21.289	588.2	17.9	7.98	211	269.2								Rocks with sand on top; hard clay about 2-	Surface and Porewater	12" achieved; 2-probe configuration
							PW		1265	21.193	1190	17.8	7.01	-57	587.7	669	-0.096	601.8	-0.1	-0.97	-268	318.5			
		7/15/14 10:05	25	42.2341189	89.1010342	120	SW	3.2	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/15/14 10:10	50	42.2341181	89.1011458	67	SW	6.2	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/15/14 10:20	75	42.2341319	89.1012369	67	SW	7.0	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/15/14 10:25	100	42.2341289	89.1013217	67	SW	8.0	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/18/14 15:55	75	42.2342089	89.1012992	130	SW	8.4	612	22.836	606.3	26.4	8.29	153	277.7								Rocky	Surface and Porewater	12" achieved after hammering; 2-probe configuration
							PW		1421	22.248	969.4	25.7	7.9	148	471.8	809	-0.588	363.1	-0.7	-0.39	-5	194.1			
22	Plume (South)	7/16/14 11:15	25	42.2323597	89.1007161	65	SW	4.5	594	21.72	589.1	19.6	8.05	169	269.9								Gravelly sand		12" achieved; 2-probe configuration
							PW		726	21.33	625.8	19.8	8.13	154	292.2	132	-0.39	36.7	0.2	0.08	-15	22.3			
		7/16/14 12:00	50	42.2323675	89.1008042	57	SW	5.6	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/16/14 12:05	75	42.2323031	89.1008969	89	SW	6.3	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/16/14 12:10	100	42.2322983	89.1009639	89	SW	6.8	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
26	Plume (South) - island back channel area	7/16/14 14:30	2	42.2306953	89.1002567	120	SW	1.8	588	22.48	618.7	26.6	7.4	236	287.2								Hard clay	Surface and Porewater	12" achieved; 2-probe configuration
							PW		753	20.709	1027	24.7	7.2	212	502.2	165	-1.771	408.3	-1.9	-0.2	-24	215			
		7/16/14 12:40	25	42.2305892	89.1003172	79	SW	5.0	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/16/14 12:45	50	42.2305633	89.1003917	89	SW	4.4	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/16/14 13:20	75	42.2305531	89.1005014	120	SW	3.3	595	22.074	588.7	22	8.11	155	268.6								Clayey with a little sand	Surface and Porewater	12" achieved; 2-probe configuration
							PW		815	21.064	724.8	22.2	8.09	163	350.7	220	-1.01	136.1	0.2	-0.02	8	82.1			
			100	NA	NA	NA	SW	NA	NA	NA	NA	NA	NA	NA	NA								--		Inaccessible
							PW		NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--	--	--			
30	Plume (South)	7/16/14 16:15	2	42.2289197	89.1007089	120	SW	2.0	598	22.543	616.5	23.8	7.92	211	284.9								Hard Clay		12" achieved; 2-probe configuration
							PW		850	21.546	597	23.7	8.33	177	273.2	252	-0.997	-19.5	-0.1	0.41	-34	-11.7			
		7/16/14 16:55	25	42.2289067	89.1007883	83	SW	5.0	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/16/14 17:00	50	42.2289094	89.1008828	92	SW	5.2	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/16/14 17:05	75	42.2289225	89.1009669	63	SW	5.4	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/16/14 17:10	100	42.2289481	89.1010442	63	SW	5.5	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
32	Plume (South)	7/14/14 18:05	2	42.2278283	89.1007558	83	SW	3.0	601	23.935	592.9	23.3	8.02	165	270.8								Silty, mud/clay w/sandy		Achieved 12"
							PW		1077	21.370	923.0	23.3	7.07	-121	450.8	476	-2.565	330.1	0	-0.95	-286	180			
		7/14/14 17:35	25	42.2278239	89.1008128	66	SW	4.6	602	23.932	596.5	23.7	7.90	191	273.7								Sandy		Achieved 12" with 1-probe configuration
							PW		864	22.316	797.5	23.6	7.14	-13	386.7	262	-1.616	201	-0.1	-0.76	-204	113			
		7/14/14 17:30	50	NR	NR	NR	SW	NR	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/14/14 17:00	75	NR	NR	NR	SW	NR	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/14/14 17:25	100	NR	NR	NR	SW	NR	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
34	Plume (South)	7/16/14 18:00	25	42.2269967	89.1004139	74	SW	3.9	598	22.45	597.2	22.4	7.94	212	273.7								Rocky on top, soft clay shallow and hard clay		12" achieved; 2-probe configuration
							PW		737	21.575	684.5	22.5	7.41	-4	328.1	139	-0.875	87.3	0.1	-0.53	-216	54.4			
		7/16/14 18:30	50	42.2269761	89.1005206	60	SW	5.7	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/16/14 18:35	75	42.2269769	89.1006258	54	SW	6.7	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/16/14 18:40	100	42.2269317	89.1006472	60	SW	7.1	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
38	Plume (South)	7/16/14 19:15	5	42.2255605	89.0992267	76	SW	1.9	599	22.292	594.7	21.6	7.78	206	280.8								Rocky sand with clay underneath	Surface and Porewater	12" achieved; 2-probe configuration
							PW		756	21.214	1158.0	22	6.82	-66	569.8	157	-1.078	563.3	0.4	-0.96	-272	289			
		7/16/14 18:50	25	42.2255325	89.0992850	84	SW	4.3	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/16/14 19:50	50	42.2254889	89.0994014	82	SW	5.8	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/16/14 19:55	75	42.2254686	89.0994336	82	SW	6.2	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/16/14 20:00	100	42.2254506	89.0995247	82	SW	6.3	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/18/14 14:55	50	42.2256083	89.0994289	120	SW	4.7	613	22.872	607.4	24.4	8.15	195	281.8								Slight sand over rock		12" achieved after hammering; 2-probe configuration
							PW		697	21.935	598.3	24.7	7.68	182	273.6	84	-0.937	-9.1	0.3	-0.47	-13	-8.2			
		7/18/14 14:05	75	42.2256283	89.0995708	59	SW	5.1	612	22.627	609.1	25.1	8.18	189	281.9								Rocky		12" achieved after hammering; 2-probe configuration
							PW		737	21.735	637.2	24.8	7.65	181	297.8	125	-0.892	28.1	-0.3	-0.53	-8	15.9			
42	Plume (South)	7/17/14 13:40	25	42.2240981	89.0979103	59	SW	3.1	608	22.221	607.9	26	8.13	138	279								clay with silt		12" achieved; 2-probe configuration
							PW		2501	21.911	2222	25.5	6.83	-144	1112	1893	-0.31	1614.1	-0.5	-1.3	-282	833			
		7/17/14 14:20	50	42.2240303	89.0979947	58	SW	6.4	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/17/14 14:25	75	42.2239892	89.0980858	58	SW	7.2	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			
		7/17/14 14:30	100	42.2239564	89.0981311	57	SW	7.2	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	--	--	--	--	--	--	--			

Transect	Area	Date-Time	Distance from Shore (feet)	Lat (degrees N NAD83)	Long (degrees W NAD83)	GPS Acc. (cm)	Medium	Water Column Depth (feet)	Measurements							Differentials							Field Notes		
									Trident Probe		Ultrameter					Trident Probe		Ultrameter							
									Cond (uS/cm)	Temp (°C)	Cond (uS/cm)	Temp (°C)	pH	ORP (mV)	TDS (mg/L)	Cond (uS/cm)	Temp (°C)	Cond (uS/cm)	Temp (°C)	pH	ORP (mV)	TDS (mg/L)	Sediment Type	Water Sample	General Comments
46	Plume (South)	7/17/14 15:10	25	42.2231169	89.0959328	91	SW	2.1	861	21.073	845.4	25.9	7.78	153	410								Sandy clay	Surface and Porewater	12" achieved; 2-probe configuration
							PW		1664	21.012	1485	25.9	6.77	73	733.2	803	-0.061	639.6	0	-1.01	-80	323.2			
		7/17/14 15:55	50	42.2231014	89.0961192	70	SW	3.2	1019	22.38	953	25.9	7.75	159	464.9								Sandy clay	Surface and Porewater	12" achieved; 2-probe configuration
							PW		1417	20.829	1120	25.2	6.94	-139	548.3	398	-1.551	167	-0.7	-0.81	-338	83.4			
		7/17/14 16:45	75	42.2230411	89.0961619	63	SW	5.1	608	22.507	609.2	24.3	7.73	211	297.8								Sand		12" achieved; 2-probe configuration
							PW		701	21.64	635.8	24.7	7.26	-114	297.2	93	-0.867	26.6	0.4	-0.47	-325	-0.6			
		7/17/14 17:35	100	42.2229714	89.0961617	1.1	SW	7.3	608	22.372	608.7	24.2	7.94	193	280.2								Sand with rock		12" achieved; 2-probe configuration
							PW		717	22.095	602.8	24.0	7.77	181	279.8	109	-0.277	-5.9	-0.2	-0.17	-12	-0.4			
50	Plume (South)	7/18/14 11:25	25	42.2216803	89.0948281	60	SW	3.6	670	21.922	664.7	23.8	7.88	179	315.3								Gravelly		12" achieved; 2-probe configuration
							PW		2212	21.372	1135	24.1	6.91	-113	556.7	1542	-0.550	470.3	0.3	-0.97	-292	241.4			
		7/18/14 12:40	25	42.2216753	89.0948311	56	SW	3.2	670	22.22	664.7	24.7	8.1	133	315.1								Gravel above sand		12" achieved; 2-probe configuration
							PW		11650	21.359	1939	24.8	6.89	-134	964.4	10980	-0.861	1274.3	0.1	-1.21	-267	649.3			
		7/18/14 11:45	50	42.2216592	89.0949475	58	SW	6.0	655	22.006	646.6	23.7	8.28	99	304								Rocky with sand underneath		12" achieved; 2-probe configuration
							PW		677	21.373	573.9	24.4	7.19	-104	258.4	22	-0.633	-72.7	0.7	-1.09	-203	-45.6			
		7/18/14 12:00	75	42.2216131	89.0950433	56	SW	7.4	616	22.214	631.9	24	8.13	179	294.7								Rocky with sand underneath		12" achieved; 2-probe configuration
							PW		1022	21.467	805.6	24.5	7.13	-114	392.3	406	-0.747	173.7	0.5	-1	-293	97.6			
		7/18/14 12:10	100	42.2216175	89.0951028	56	SW	8.4	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	–	–	–	–	–	–	–			
53	Plume (South)	7/18/14 10:20	5	42.2203408	89.0946672	130	SW	1.5	644	21.638	657.5	21.6	7.77	230	311.5								Hard Clay	Surface and Porewater	12" achieved; 2-probe configuration
							PW		2686	20.644	2428	21.8	6.82	-110	1221	2042	-0.994	1770.5	0.2	-0.95	-340	909.5			
		7/18/14 10:05	25	42.2203553	89.0947406	67	SW	3.0	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	–	–	–	–	–	–	–			
		7/18/14 10:50	50	42.2203731	89.0948583	57	SW	2.2	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	–	–	–	–	–	–	–			
		7/18/14 10:55	75	42.2203600	89.0949603	56	SW	3.4	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	–	–	–	–	–	–	–			
		7/18/14 11:00	100	42.2203503	89.0950364	55	SW	4.3	R	R	R	R	R	R	R								Rocky		Refusal
							PW		R	R	R	R	R	R	R	–	–	–	–	–	–	–			

Notes:
R = No data collected due to refusal of the probe by rocky substrate
NR = Not recorded
NA = Not available
Myron meter temperature readings may not be reliable due to changes in temperature during sample collection

Attachment 2
Photograph Log

Photograph Log

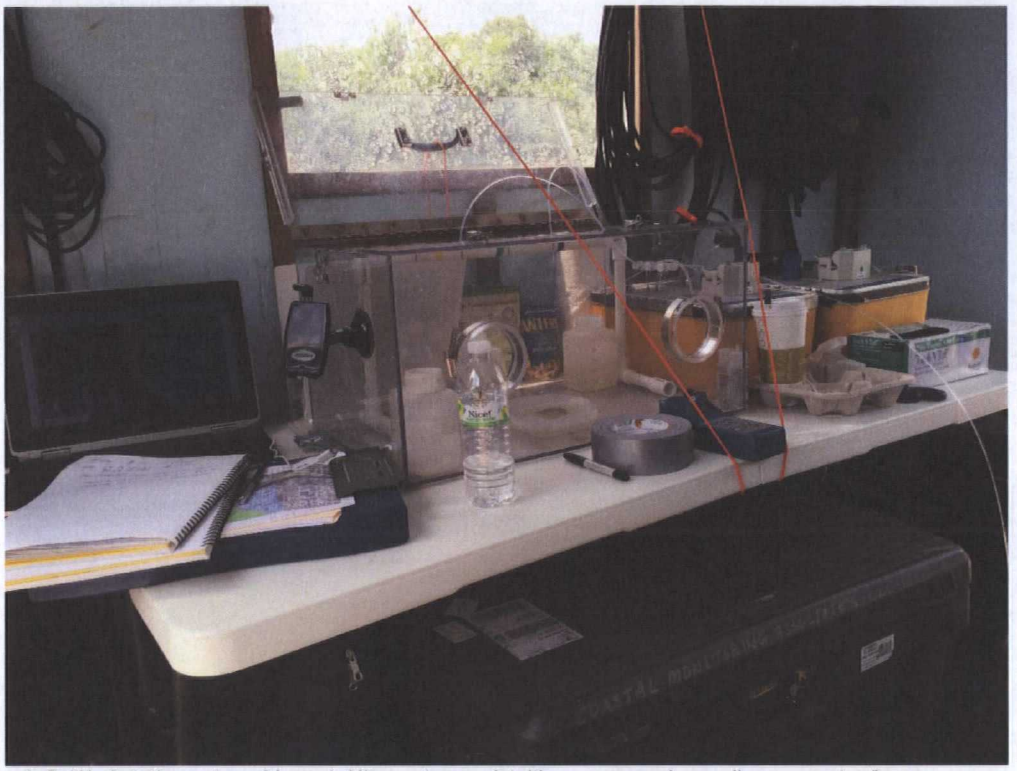


***Photograph 1**: Trident Probe system showing water quality probes, water sampling probe, and push-pole.*

***Photograph 2**: Trident Probe sub-surface conductivity/temperature probe (top) for pore water measurement's and sampling probe (bottom).*

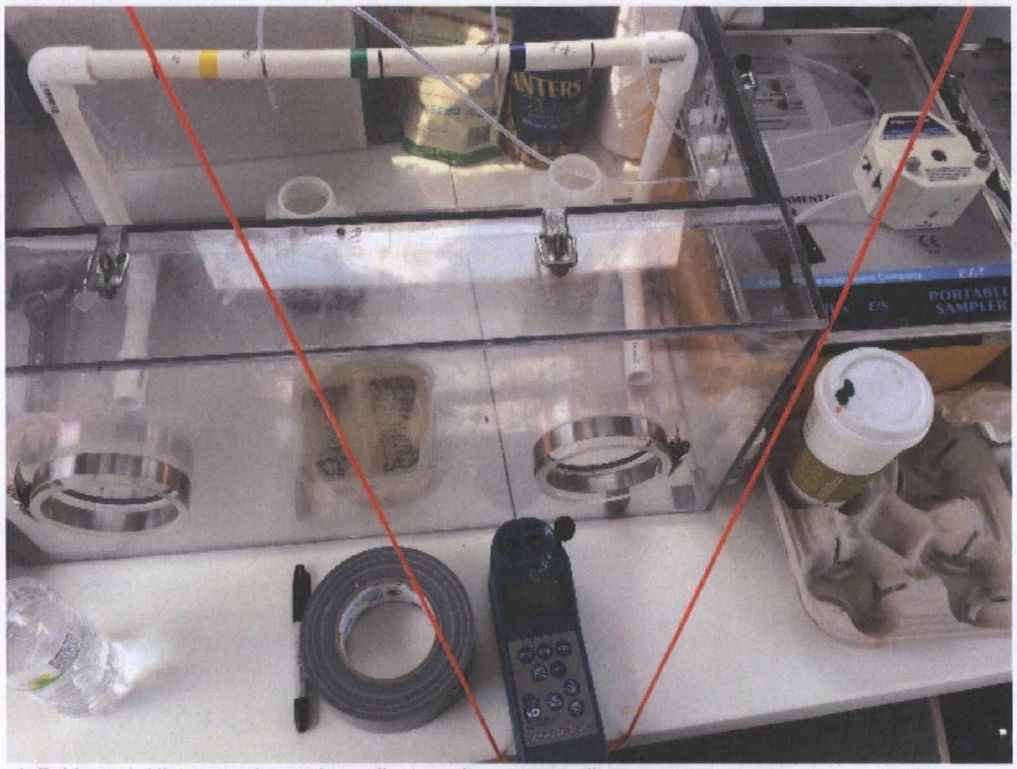
***Photograph 3**: Trident Probe sub-surface sampling probe with sand filter screen removed.*

***Photograph 4**: Subcontractor CMA launching sampling vessel into Rock River.*

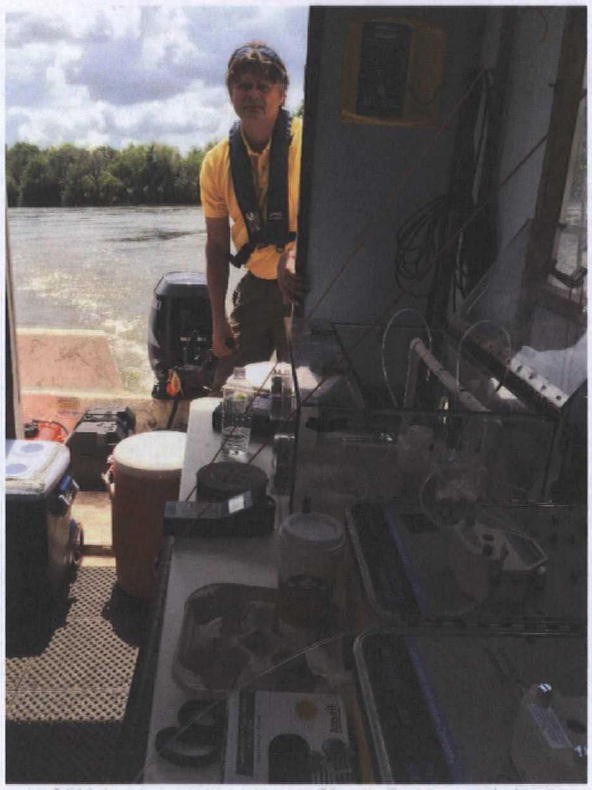


***Photograph 5**: Workstation set up, Myron L Ultrameter, peristaltic pumps, and sampling apparatus/box.*

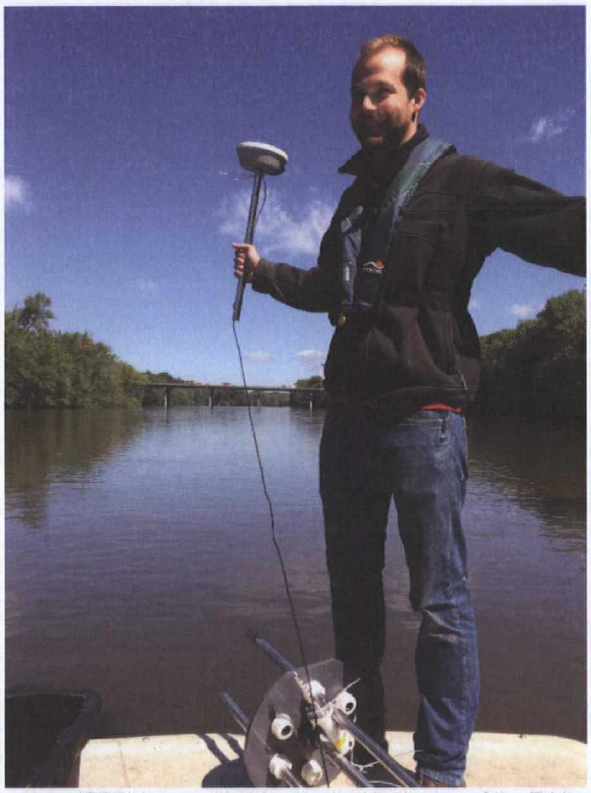
***Photograph 6**: On-board sampling setup; Simultaneous collection of surface and pore water samples for hardness analysis (same set-up used to collect sample for ex situ water quality measures and to bottle sample for VOC analysis).*



Photograph 7: Myron L Ultrameter is used to collect ex situ water quality parameters.

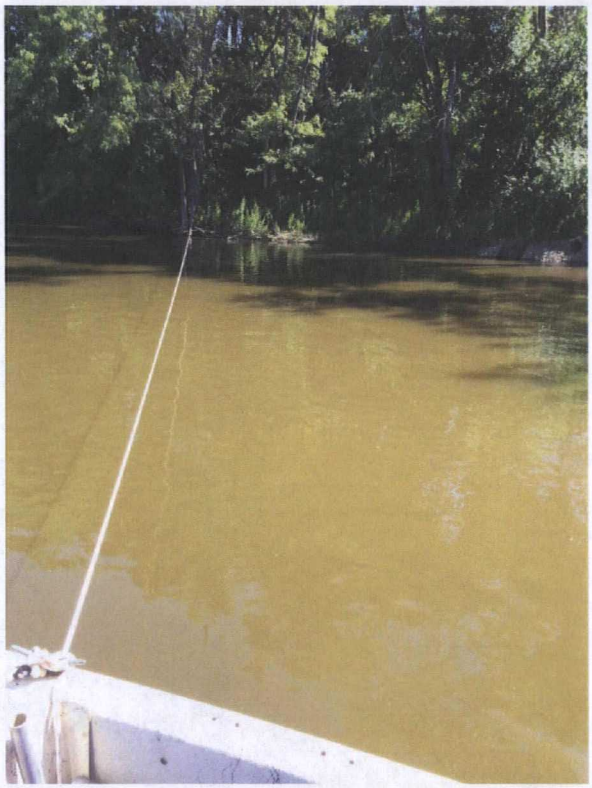


***Photograph 8**: Background shows CMA boat captain at stern of boat; Foreground shows peristaltic pumps used to draw porewater and surface water for sampling.*



***Photograph 9**: Global positioning system (GPS) beacon that is attached to the top of the Trident Probe system or held above sampling position to obtain survey/sample coordinates.*

***Photograph 10**: Rocky substrate from river bottom within the investigation area.*



***Photograph 11**: Shoreline of the Rock River in investigation area, displaying technique for tying off to shoreline to position on sample location within transect (not pictured is anchor set off stern of boat).*